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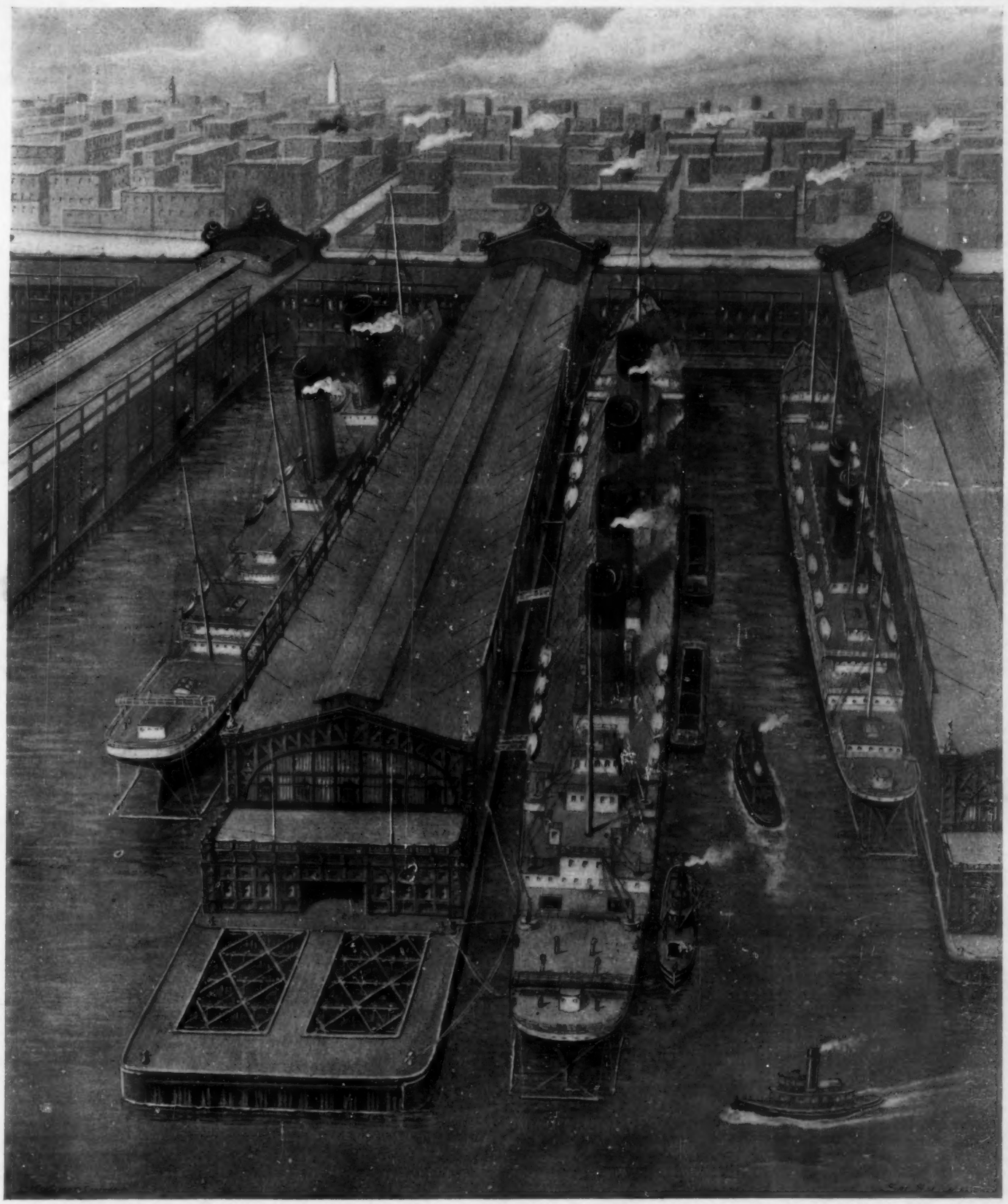

In the foreground is shown the temporary 100-foot extension of the pier which is built of open piling with free passageway for the tidal flow. In the same basin with the "Olympic" is the "Finland," 580 feet in length. In the adjoining basin is the 704-foot "Oceanic." The "Olympic" is 882½ feet long.

THE "OLYMPIC" AT HER 900-FOOT PIER, NEW YORK.—[See page 619.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Gould-Scientific American Prize

THE conditions under which the prize of $15,000 which Mr. Edwin Gould promised, through the columns of the SCIENTIFIC AMERICAN, to award "for the most perfect and practicable heavier-than-air flying machine, designed and demonstrated in this country, and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together," fixed the date June 1st, 1911, as the final day upon which entries were to be received, and July 4th, 1911, and following days as the dates upon which the contests themselves were to take place.

The many letters which we received, expressing approval of the motive that prompted Mr. Gould to offer the prize, led us to hope that a considerably greater number of machines would be submitted than are actually forthcoming. By June 1st five designers had entered their machines, but of these, as subsequent correspondence revealed, only one declared himself ready to submit a machine to the testing committee on July 4th, 1911. Since the conditions state that "at least two machines must be entered in the contest or the prize will not be awarded," it is obvious that there can be no competition. In view of these facts, Mr. Gould has generously consented to repeat his offer for another year, after which it will be definitely withdrawn. The conditions will remain exactly as they are, with the exception that one or two will be added which will not in any way affect the plans of designers who may have intended to compete, but were prevented from doing so because of the limitations of time.

One year means much in aviation progress. In the next few months there will be established in this country a plant for the manufacture of at least one well-known French biplane. That other French manufacturers will follow suit seems almost certain. Within the coming year, therefore, entrants for the Gould prize will be in a better position to carry out their ideas than now. Until recently there were only two well-established types of American flying machines, and two factories in which the building of the flying machine proceeded with anything like regularity and system. Most of these establishments limit their output entirely to machines of their own design. Because there have been no plants conducted by men of experience to whom entrants for the Gould-SCIENTIFIC AMERICAN prize could turn, it is in a way natural that the prize should not be awarded on the coming July 4th. Manufacturing facilities play a large part in contests such as these; at least we judge so from the fact that despite the express limitation of the competition to Americans, we received communications from foreign aviators who desired to enter and who could turn to at least a dozen factories in France alone for assistance in constructing a machine which would fulfill the requirements. With the establishment in this country of branches of French aeroplane factories by men of large experience the prospects for the Gould-SCIENTIFIC AMERICAN prize from July 4th, 1911, to July 4th, 1912, are brighter than they were.

The rules governing the competition for the prize will be published from time to time in the columns of the SCIENTIFIC AMERICAN, with the additional conditions previously referred to.

The Preservation of Niagara Falls

THE widespread awakening of the public mind to the importance of rendering the environment of human life as beautiful and elevating as possible, consistently with the daily routine of our busy modern life, is one of the happy omens of the time. Evidences of this awakening are many and various. It is visible in our domestic architecture, and in the interior furnishings of our homes. Its recognition has led to the demand that our public buildings shall be monumental, not merely as to their mere bulk, but in the just balance and proportion of their masses, and in the appropriate character of the details. Our best architects are striving, with a zeal which is worthy of a better success, to lend some touch of beauty to that modern monstrosity, the sky-scraper building. Most promising, also, is that recognition of the inherent monotony and ugliness of many of our modern cities, which is expressed in the new movement in the direction of civic government.

Further evidence is shown in the growing determination of the American people to preserve intact the more notable of the objects of grandeur and beauty, with which the hand of Nature has so liberally enriched the United States. The legislation which has thrown its protection around the Yellowstone Park, the Yosemite Valley, the groves of majestic trees in California, and the various national reserves of the country, has rendered, both to the people of to-day, and to all posterity, a service which will be acknowledged with growing emphasis as the years go by. Never, we believe, has preservative legislation of this character received such widespread approval as that which saved the majestic Falls at Niagara, already sadly defaced, from further spoliation by hydraulic power plants. The interest in the Falls is more than national—it is worldwide; and the traveler from other countries, be he European or Asiatic, considers that his itinerary is scarcely complete unless it has included Niagara. Hence the announcement that the integrity of the Falls had been forever insured by an international treaty between Canada and the United States, was received with all but universal approval. There are other great waterfalls in existence, it is true, notably the majestic drop of the Zambesi River at Victoria Falls; but they are more or less inaccessible—altogether so, in fact, to the traveler whose purse is limited; whereas Niagara, by virtue of its accessibility, is open to the world.

It is that very magnitude of the Falls, which lends to them their majestic beauty, that has brought about the threat of their destruction. Those thousands of tons of water, falling ceaselessly through a height of 150 feet, awaited only the development of the water turbine, the electric generator, and the copper transmission line, to render the commercial exploitation of the Falls an exceedingly attractive proposition.

Now the SCIENTIFIC AMERICAN would be the last to depreciate the technical skill with which the various power companies, through their engineers, have planned and built the huge power houses which are at present in operation. These, together with the various electro-chemical and other industries which have sprung up at Niagara, are among the most creditable works of their kind. From time to time, they have formed the subject of illustration and description in the columns of this journal, as our readers well know. But, at the same time, we have always been alive to the fact that the water drawn from the upper river detracted from the beauty of the Falls, and that the various buildings, admirable as is the architecture of many of them, have been a discordant feature in those landscape surroundings to which the scenic beauties of the Niagara River, Falls, and Gorge are largely due.

It is natural that the power companies should wish to take additional water from the Falls; it is also readily understood that certain interests in the city of Niagara and other contiguous localities may be interested in the further extension of manufacturing interests that draw their power from the companies. In our correspondence columns will be found a letter of protest, from a citizen of Niagara Falls, which will be read with interest. The question, however, is one which must be considered from the broadest possible point of view. Our conviction that the Falls have been damaged, as stated by Government engineers, is verified by the personal observation of the Editor. Further depletions of the flow will mean the unwatering of shallow places and a further reduction of the crest line. If ever there was a question in the solution of which the greatest good to the greatest number should be the governing principle of action, surely it is to be found just here.

The Unification of Science

THE division of the entire realm of science into a number of separate domains seems to be the result, not so much of an inherent variety in the phenomena that come within our ken, as of certain peculiarities of our senses. The same sun's ray which, entering the eye, causes a visual sensation, will, if received upon a sensitive portion of the skin, give rise to a feeling of heat. It is true that there are "heat rays" incapable of affecting the eye; but a study of the phenomenon shows that the seeming separation of this heat radiation from light is not due to any objective discontinuity, but to the limitations of our organ of sight. In point of fact, there is a perfectly continuous and gradual transition from the rays of short wave length perceived by the eye, to the longer waves of which we become cognizant only by our heat sense. Nor does the matter end there. We can follow up further this continuous sequence of waves, to a point where once more there is a discontinuity, not in the range of phenomena observed, but in the methods available for their observation. In this way the identity of light, radiant heat, and electro-magnetic radiation is established, and the barriers dividing three fields of physical science fall to the ground.

If we turn from the consideration of radiant heat to the phenomenon presented by the intrinsic heat of matter, we find a similar state of affairs prevailing. That the "heat" of a body, as manifested to our sense of touch by its temperature, consists in the rapid motion of its ultimate particles, themselves too small to be directly observed by our senses, was surmised as early as 1620 by Francis Bacon. The final substantiation of this point of view may be said to have been furnished only in quite recent times by the work of Zsigmondy and his followers upon ultra-microscopic particles and the Brownian movement. Thus the phenomenon of heat is brought within the pale of mechanics. Sound, for which also we possess a special sense, and which thus forms the subject of a separate branch of physics, has, of course, long been interpreted as a mechanical effect.

The whole range of "physical" phenomena is therefore gathered under two main divisions—the mechanics of material systems on the one hand, and electro-magnetism on the other. And is the process of unification to stop there? Or are these two last divisions also to be merged into one? There is much in modern electrical theory which seems to point in the latter direction. Strange to say, however, it is not electricity, the more intangible, the more remote, which seems to be expressible in terms of matter, the more obvious, but apparently rather the reverse. A fundamental property of matter is inertia. A species of inertia is possessed also by an electric charge, and perhaps all inertia is of the electro-magnetic kind, and all matter is electricity. As yet these questions are undecided.

If we look beyond the bounds of "physical" science in the narrower sense, we see signs of the same unifying tendency. It is true that chemistry still stands apart, defying all attempts at interpretation purely in terms of other physical concepts. But much has been done in developing the ground on that border land where the two sciences meet.

The more sanguine among us perhaps look with some confidence to the coming of the day when chemistry will be merged into physics. More hesitation will be felt in foretelling a similar fate for the biological sciences. Many think that there are elements involved here, which are not reducible to purely physical entities. Such a question only the future can decide. In the meanwhile we must welcome the movement among certain biologists, which makes for exact quantitative methods, and lays stress on the investigation of those aspects of life phenomena, which are beyond question of physical character, and as such are governed by physical law. From such works as Le Dantec's recent book, "La stabilité de la vie," should spring a branch of science which bears the same relation to biology as physical chemistry does to the older descriptive portion of that science. Whether science will ultimately be found to fuse into one whole, or to remain divided into two or more domains, irreducible to lower terms, it is at present impossible to say. Quite unmistakable, however, is the modern tendency for unification, a tendency which springs perhaps in part from a natural bias of the human mind, but which seemingly is due at least in part also to the properties of the "objective world" around us.

Sir Hiram Maxim

The Autobiography of a Veteran Inventor

[*The fact that the following sketch of his career was written by himself will lend particular interest to this biography of Sir Hiram.*—Ed.]

SIR HIRAM MAXIM is of Puritan parentage, and was born in Sangerville, Me., February 5th, 1840. He was educated at the common schools, and at the age of 16 commenced to serve an apprenticeship as a carriage maker at Abbott, Me., working in the summer time and going to school in the winter, up to the age of 20. Here he made a tricycle with bicycle wheels of the present type. These are believed to have been the first wheels ever made in American in which the hub was suspended by spokes in tension.

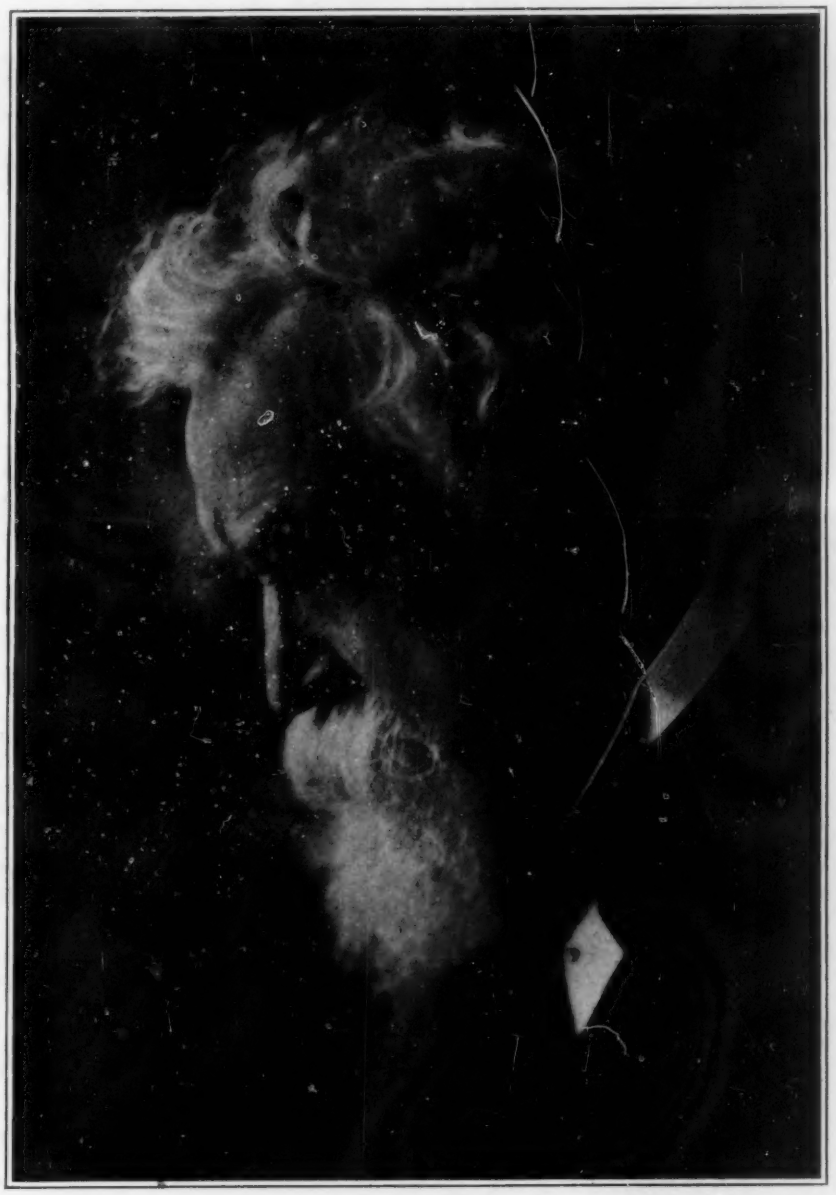
During the civil war he was employed at the engineering works of his uncle at Fitchburg, Mass., where he worked first as a machinist, then as a brass finisher, and finally as a draughtsman. During the last year of the war he left Fitchburg and went to Boston, where he entered the employ of Oliver P. Drake as a draughtsman. Drake was a very clever philosophical instrument maker, and also a builder of automatic gas machines.

While at Boston, Maxim invented many different forms of gas machines. From Boston he went to New York, where he was employed as a draughtsman at the Novelty Iron Works at the foot of East Twelfth Street. At that time this firm had in hand the building of the Pacific Mail steamers.

It had been said by those who pretended to know that there was no possible way of making a machine for carbureting air for illuminating purposes, which would produce a mixture of a uniform density, but Sir Hiram discovered no less than three separate systems of accomplishing this. In one system, the regulating device was operated by the expansion of the air during the carbureting step. If it was carbureted too much, the expansion produced a pressure that opened a valve and allowed air to pass directly from the air pump into the pipe leading to the burners. In another system, the regulating device was operated by the specific gravity of the gas. For this purpose a cylinder was suspended on a scale beam in the gas. If the gas was too rich, the cylinder was buoyed up and by this movement a valve was opened which shunted the air around the carbureter. A very large machine of this type was made at the Novelty Iron Works for the Americus Club in Connecticut, of which Bill Tweed was a member. This was followed by another system in which the gasoline was first converted into a vapor by heat under a pressure of 35 pounds to the square inch. The vapor in escaping was made to force the necessary air into a gas holder. This machine made gas of an absolutely uniform density and of any density required, and came into very general use. One was placed in the New York post office, another in the Woman's Home, New York. All of A. T. Stewart's mills were equipped with such machines, and one with a capacity of 10,000 burners was installed at Saratoga Springs, where it lighted the Grand Union Hotel, the St. James Hotel, and the Windsor Hotel.

Later on, Sir Hiram took up the subject of electricity, made many inventions, and took out many patents. He made all the apparatus and put up the first illuminated fountains at Saratoga Springs, N. Y. He was the true inventor of the system of flashing which made incandescent lighting possible, that is, he discovered a process of building up and standardizing the filaments of electric light by heating them electrically in a highly attenuated atmosphere of hydro-carbon gases. He discovered a new process of making phosphoric anhydride, reducing the cost from five dollars to fifty cents per pound. He made the first regulator for keeping the pressure constant in an electric lighting system quite independently of the number of lights on the circuit. This apparatus was exhibited in Paris in 1881, and Sir Hiram was made a Chevalier of the Legion of Honor.

In 1883 he left France and went to London and commenced work on an automatic gun. Up to that time no one had ever attempted to make an automatic gun. The first gun made was operated by the backward movement of the cartridge in the barrel at the instant of firing, a system which is largely used in automatic pistols at the present day. But this system would not work with the long bottle-neck military cartridge, so the next gun made worked by the recoil of the barrel and breech block, that is, when the gun was fired it was allowed to recoil one inch, and the energy thus developed performed all the functions of bringing the cartridges into position, transferring them from the belt into the barrel, firing them, extracting the empty cases, expelling them, cocking the hammer and bringing the new cartridge into position.



Photograph by Hoppé. **SIR HIRAM MAXIM**

When it was announced in the newspapers that an American engineer having a little workshop in Hatton Garden, London, had made a machine gun that would actually load and fire itself, at the rate of 600 rounds in a minute, from energy derived from the burning powder, the public were incredulous; it was altogether too good to be true. But the little gun was very much in evidence and everyone came to see it, from the Prince of Wales down. Over 200,000 rounds of fully loaded military cartridges were used in showing the gun to visitors. This invention put Sir Hiram in the first rank of scientific men. It was thought that as he had solved such a difficult problem that he might solve others.

At that time the British government was about to pay a very large sum of money for the secret of the German slow burning brown powder. Many of the scientific men of London had analyzed the German powder and found that it contained no new element; they could make an exact imitation of it, but the German powder produced low pressures and high velocities and the English imitation produced high pressures and low velocities. Everyone had attempted to find out the secret by chemical means, but Sir Hiram attacked it with his microscope and found that the German powder was slow burning because the crystals of niter, although small, were many hundreds of times greater than in the English powder. The mystery was solved and the money saved.

Sir Hiram followed this up by making a hundred different kinds of powder in a single day, all of different degrees of slow burning. The sulphur and charcoal were put in the mill and thoroughly ground and incorporated; the niter was then added and specimens taken out as the process advanced. The first specimens were very slow and the last extremely violent.

This led to a great number of other experiments with powder.

At the beginning of 1885 many officials expressed their opinion that the Whitehead torpedo could not be relied upon in a heavy sea, and Sir Hiram was requested to design a very large gun for throwing aerial torpedoes through the air instead of propelling them through the water. On May 30th, 1885, he patented the gun desired and proceeded to make one. The projectile was provided with a delayed action fuse working on the same plan as the best fuses of to-day. The experiments with this large gun led to the manufacture of the first cordite, and curiously enough this cordite had the exact diameter and appearance of the British cordite that was made some years later. Chemically, it differed but slightly from the ballistite of Nobel.

In the early spring of 1888 Sir Hiram was requested by some high British officials to turn his attention to the manufacture of a smokeless powder, and experiments were conducted through the summer which led to patents being taken November 8th, 1888. This was followed by many other patents on various kinds of smokeless powder. (See *Engineering*, January 27th, 1911.) Among these patents is one for a mixture of nitro-glycerine, gun-cotton and oil. The application for a patent covering this was filed fourteen days ahead of another application for practically the same thing handed in by Prof. Abel and Prof. Dewar. In the end, however, it was found that the original cordite made by Sir Hiram in the apparatus patented in 1887 was a practical smokeless powder. It was a powder made by this process that was exhibited at Springfield, Mass., the first smokeless powder ever known in the United States.

When the French were boasting of a very remarkable explosive that they had discovered and which could be shot through armor plate without exploding from the shock, Sir Hiram set to work and very soon discovered that this much boasted explosive was a modified form of picric acid. He made it in England and it is practically the same as what is known as

(Continued on page 631.)

Our National Earthquake Recorder

Feeling the Earth's Pulse

By Emma M. V. Triepel, B.S.

THERE is a widespread impression that earthquakes grow more numerous as our earth ages. Certainly we hear of them more frequently than our predecessors did. But this is mainly because of our increased facilities for transmitting the tidings of such occurrences. They have been studied and theorized upon from the earliest times of which we have any knowledge, but the ancients had such immature concepts of the constitution and environment of the earth that they accomplished little of permanent value. However, they invented some crude instruments which showed the passing of earthquakes and the direction in which they traveled. Such a contrivance was in existence in China as early as 650 B. C.

During recent years of scientific activity these phenomena have received their share of attention. All the causes of earthquakes have not been determined, but it is agreed that contraction of the earth's crust and consequent cracking is one of the most potent in producing them. In regard to the recording and measuring of seismic disturbances, great progress has been made. Each of the more important countries has now its system of seismographs, set up for the purpose of facilitating study along that line.

In the United States this work is conducted by the Weather Bureau under the direct supervision of Charles F. Marvin, Professor of Meteorology, to whom is due the credit for developing the seismograph in his office up to its present state of completeness so that it includes all the more important features evolved hitherto by himself and other investigators, improved by him to the highest degree of efficacy.

In order to attain accuracy in a seismograph several requirements must be satisfied. The whole instrument must be extremely sensitive, yet it must be so fashioned that it can withstand the most severe earthquake without derangement of its functions. It must as far as possible be free from such disturbing influences as fluctuations of temperature and surface tilting, it must be easy to manipulate, to adjust and to maintain, and its method of registration must be as nearly infallible as it can be made.

The essential features of a seismograph are three in number, viz.: I. The steady mass. II. The transmitting apparatus. III. The recording mechanism.

I. The steady mass is the basis of the whole instrument, its function being simply to remain at rest throughout all shocks, whatever their intensity. In Prof. Marvin's seismograph the steady mass weighs 1,300 pounds and is in the form of an inverted pendulum as shown in Fig. 1. The length of its vertical support is 17 feet. The whole is inclosed within a solid pier of masonry. A post hole extends several feet below the pier and in this a piece of iron pipe, closed at the bottom, is set up vertically upon a good strong footing of concrete. The strut for the steady mass terminates at the end in a type of universal pivot. The steady mass and strut with its suspension can be inserted and removed from the pier without derangement of the suspension. It is rendered astatic by the reaction of a cylindrical steel spring rod, which is fixed at the center of percussion of the whole mass. It is necessary that its reaction upon the suspended mass shall coincide as closely as possible with the force of gravity so as to neutralize it.

The ribbon steel suspension and the peculiar fitting of the spring aid in the elimination of friction. At the lower end the spring is fitted on a slight taper and is driven into a massive metal plug; at the top it is attached by means of a screw clamp to a flat, tempered steel disk, which in turn is securely clamped around the periphery to the top of the pier. The greatest care is taken to center the steady mass vertically above its pivots. Both the spring rod and the plate must be of the best spring-tempered steel to secure thorough elasticity, and both must be adjusted as perfectly as possible.

The method of building the mountings of the steady mass within instead of upon the pier secures solidity and invariability to a high degree besides eliminating unequal changes of temperature in different parts of the apparatus, which may cause shiftings of the zero position in exposed seismographs.

II. Several requirements must be satisfied in the transmitting apparatus: 1. A maximum motion must be allowed for. 2. The linear components of motion must be taken off and recorded separately. 3. Friction must be reduced to a minimum. 4. The motion lost in transmission must be as little as possible. 5. The proportion between the motion received and that transmitted must be uniform whatever the extent of motion or its range. 6. Conditions of simplicity, accessibility, adjustability and convenience of manipulation and maintenance must be secured as nearly as practicable.

Prof. Marvin has developed the spring-bow method of magnification transmission, the plan and elevation of which is seen in Fig. 2. The topmost extremity of the steady mass terminates in an adjustable pin *p*. Two adjustable hardened steel cups, shown at *c*, are inserted at right angles to each other, one above the other. *S* is a piece of steel wire 0.044 inch in diameter, resting in *c* and bent in the form shown. The hooks *h*, *h'*, are formed of fine wire coiled and slipped over *S*. *W* is a fine skeleton wheel mounted on a free-moving, pivot pointed axis. The rim of this wheel is provided with three grooves marked in units of 0.001 of an inch. At one side of the wheel a hole is made through the rim at the bottom of each groove. One end of a piece of ordinary silk sewing thread is passed through each of the holes in the outside grooves, the free ends being afterward knotted together. A loop of the thread is pulled through the hole in the bottom of the central groove, leaving the knot on the inside of the rim. The thread is attached to the spring bow by means of the hooks at *h''* and *h'''*. The spring bow is suspended in a free moving fashion by means of a thread. The small weight *wt* serves to keep the point of the spring *S* in the cup *c*.

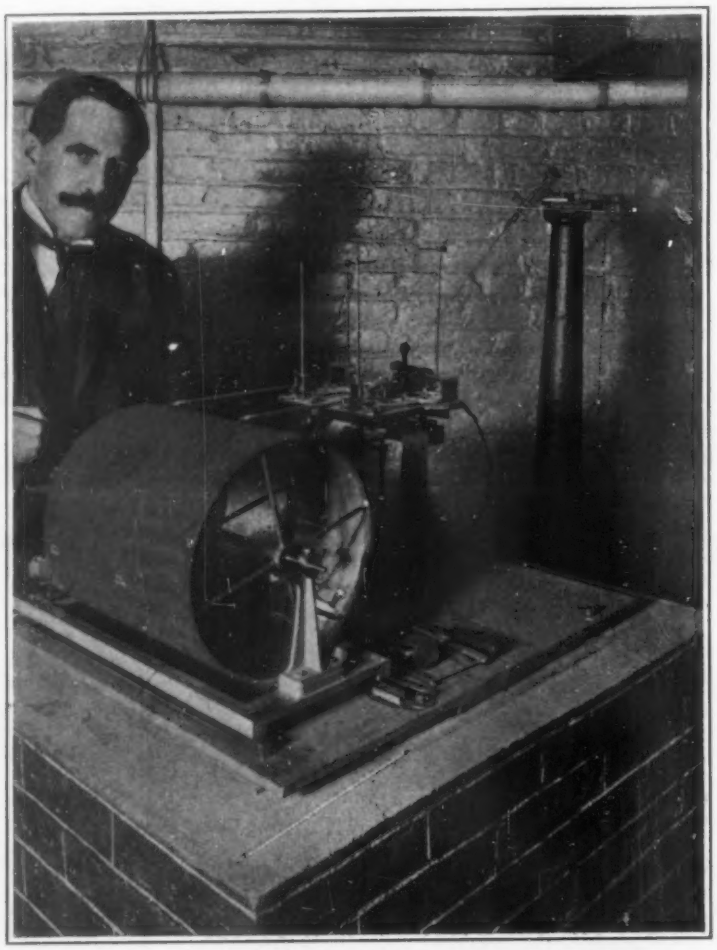
This system takes off the motion very smoothly, obviating shake, lost motion and friction. The arrangement of the double thread in the three grooves secures a perfect balance of internal forces. The action of the spring bow takes up symmetrically any slight variations of the thread from moisture or other causes; the tension is equalized by the threads being free to slip over the hooks *h''* and *h'''* when parallel to each other. The wheel *W*, if one inch in diameter, provides for 3.14 inches of motion and more than one turn of the wheel can be made.

Through this arrangement one component of the motion is transformed into approximately one turn of the wheel *W*.

To transmit this motion with the necessary magnification to the record sheet a system of levers shown in Fig. 3 is employed. The distinguishing features of this system are the means by which the motions of the levers stop when they reach a certain extreme position. But the motion of the wheel *W* and its connection with the steady mass are not limited by the levers. For this purpose devices similar to those employed in the lever escapement of all ordinary watches are used. A pin *P* on the wheel *W* engages a forked opening in the lever. Underneath the fork of the lever a small pin enters the notch or opening in the flat rim of *W*.

When the motion of the wheel *W* carries the pin out of the fork in the lever, the pin below the fork has likewise passed out of the notch in the rim, and the lever is prevented by the rim from returning until the return movement of the wheel accomplishes a re-engagement of the pin *P* and fork. The end of the lever opposite the fork is provided with a delicately pivoted pin *P*, which in turn engages a fork in

(Continued on page 631.)



Seismograph of the Marvin system at the United States Weather Bureau.

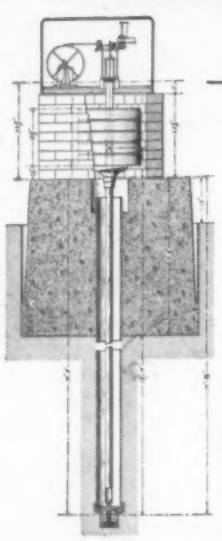


Fig. 1.—Marvin inverted astatic pendulum seismograph.

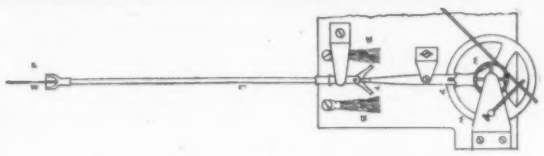


Fig. 3.—Arrangement of levers for transferring motion.

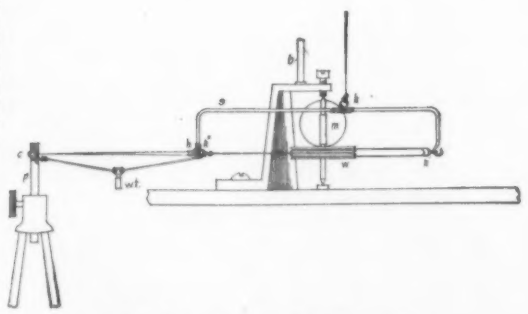


Fig. 2.—Plan and elevation of the spring-bow and wheel transmission.

FEELING THE EARTH'S PULSE

Uncovering the "Maine"

How the Work at Havana is Progressing

ALTHOUGH there may be a touch of the morbid in the widespread interest which has been aroused by the present attempt to recover the "Maine" from the waters which for so many years have given it sepulture, the public interest is something more than morbid. Rather, it is sympathetic and respectful, and fully conscious of the tremendous dramatic and political significance which must ever attach to the pitiful tragedy of 1898. Whether the ship went down to her present resting place by accident or design, the fact remains that the wreck of the "Maine" was the immediate and most potent cause of that upheaval of public opinion which resulted in the Spanish-American war.

Time, that great assuager of bitter animosities, has done its work well during the past dozen years, and has left in the minds of both contending nations a desire to ascertain the exact truth regarding the causes of the "Maine" explosion. If it shall be proved that the first explosion came from within, it will be cause for congratulation, since in that event no reflection will be cast either upon the good ship "Maine" or its personnel, whereas the elimination of the theory that the ship was deliberately blown up from without will take from a proud and friendly nation the sting of a charge which they, at least, have always claimed to be unjust and unwarranted by the facts. Magazine explosions due to the deterioration of powder have been known to occur, especially since the introduction of smokeless powder. The case of the French battleship "Jena" is still fresh in our minds. Improved powders possessing satisfactory chemical stability, and refrigeration of the magazines to preserve the powder at a safe temperature, have practically eliminated this risk from the modern warship. It will be best for all concerned, and will certainly cast no reflection upon the ill-fated ship or its officers and crew, if it shall be found that the condition of the unwatered wreck shows the force of the explosion to have been from within.

The plan adopted by the army engineers for examining the hull of the vessel was to build around the wreck a massive, watertight wall, pump out the water, leaving the bottom mud exposed, and then dredge away the mud from around the hull, leaving the latter in condition for examination. The cofferdam wall, which is elliptical in plan, consists of a series of cylinders 40 to 50 feet in diameter, which were formed by driving down to firm bottom circular cylinders composed of interlocking steel piles, each cylinder being built by driving the piling piece by piece until the circle was complete. To make the joints between the cylinders watertight, a segmental wall of piling was put down between each pair. After the work was completed the cylinders were filled with clay and material dredged from the harbor.

All that now remains to be done in exposing the "Maine" is to pump the cofferdam dry, and this work is now in progress. At the time the accompanying photographs were taken, the water level had been reduced some five feet or more, or sufficiently to expose the quarter deck, which thus for the first time comes to view after being for thirteen years below the surface. The portions of the wreck that have been exposed are about in the condition that was to be expected, being heavily coated with barnacles and marine growth.

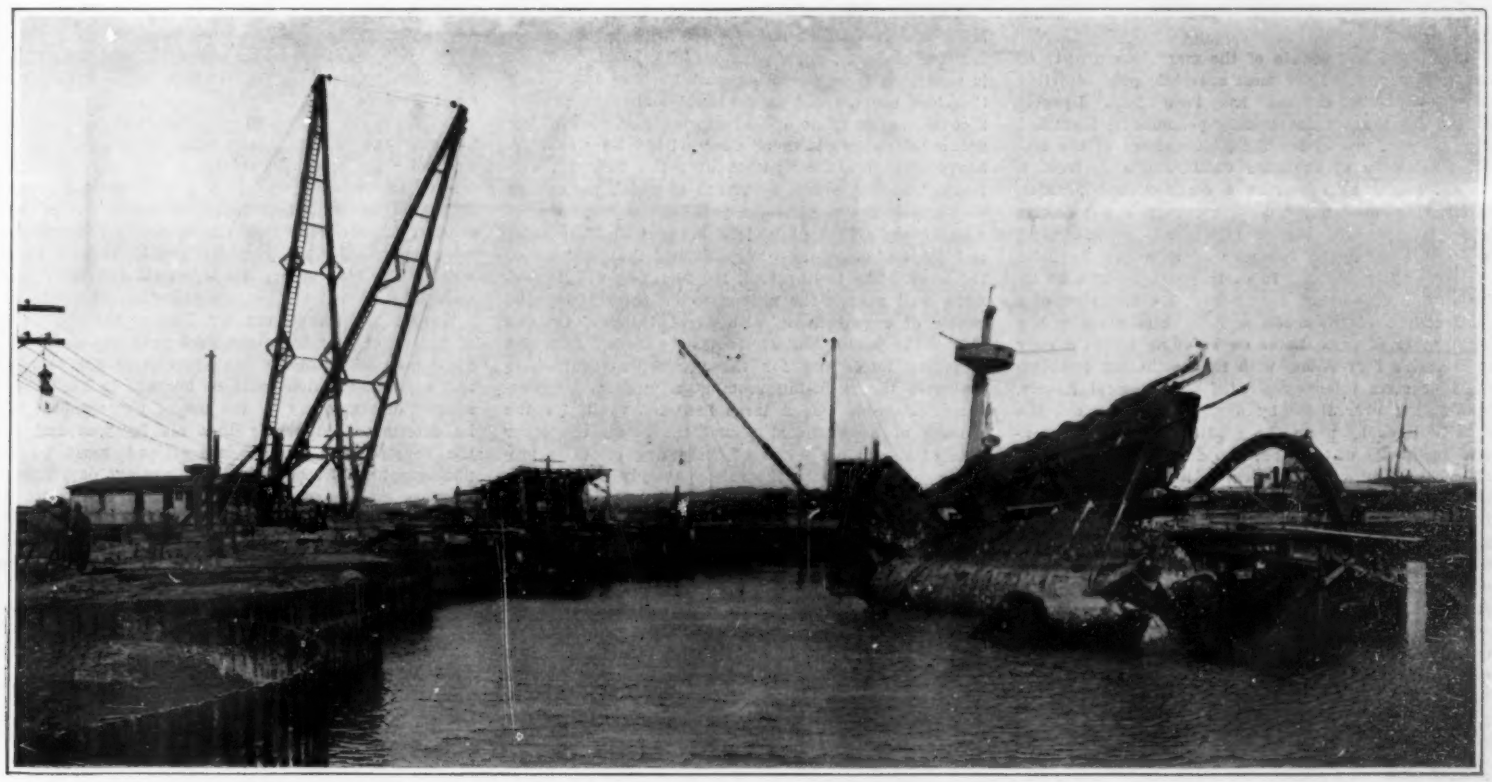
The many fears which have been expressed that the cofferdam wall would be unable to withstand the inward pressure of the water have thus far proved to be groundless, since at the present writing the work is both watertight and stable. The "Maine" lies, however," in 37 feet of water, and when this has been removed the full test will come. However, the pumping is being done gradually, and as the water inside is lowered, the behavior of the cofferdam is being carefully watched for any indication of weakness or serious seepage. Should the wall show evidence of yielding, it will be possible to strengthen it by dumping rock back-filling against its interior wall, and, if need be, by running heavy timber struts between the cofferdam and the wreck; although much reliance cannot, of course, be placed upon the resisting strength of the badly shattered hull.

Note the elliptical wall of cofferdam, consisting of circular, steel-pile cylinders, filled in with clay and silt.

Bird's eye view of cofferdam and wreck.

The quarter deck is just exposed; forward are the mainmast and the upturned steel deck.

Five feet of the "Maine" exposed.



View inside cofferdam after water was lowered five feet. The confused wreckage shows the center of the explosion. The curved member to the right is a boat crane. The mass to the left is the steel deck (under side) which was thrown upward and backward by the blast of the explosion.

UNCOVERING THE "MAINE"

John D. Hooker and the One Hundred-inch Reflector

A Business Man Who Took an Interest in Astronomy

By Mary Proctor

IT is a subject for comment that the largest telescopes throughout the world have been constructed by the liberality of individuals, and perhaps a majority of the greatest discoveries, as well in astronomy as in the other sciences, have been made by those working in a private capacity, with their own instruments and in their own observatories, and having no connection with any public institution. In January, 1610, Galileo amazed the world by his discovery of the four moons of Jupiter, with the aid of a small lens endowed with a magnifying power of only 33 diameters. Since then, more powerful instruments have been constructed, culminating in the Lick equatorial of 36 inches, the Yerkes equatorial of 40 inches, the 60-inch reflector, and the Snow horizontal reflector of 24 inches, both on Mount Wilson.

The summit of Mount Wilson is nearly six thousand feet above the ocean, located but a short distance from Los Angeles, the metropolitan city of southern California, in a district exempt from hurricanes, with an atmosphere free from disturbances, and affording advantages unequaled by any other known place. For this reason it was selected a few years ago by the Carnegie Institution as a suitable site for the erection of the 60-inch reflector already referred to, and the results obtained have proved the wisdom of this choice. Wonders of the starry regions have been disclosed by means of the photographs taken with this reflector, far excelling the powers of definition hitherto obtained by the largest refractors. For the reflecting telescope is superior to refractors in photographing the nebulæ, etc.

During the last decade of the marvelous growth of Los Angeles, one of her most energetic public-spirited and prosperous citizens has been John Daggett Hooker. A man of unassuming personality, identified with all good works for the advancement of the material interests of southern California and, from a modest beginning achieving a distinguished position in the mercantile world, he has been a leader among those working for higher intellectual advancement, more particularly in the way of affording facilities for scientific pursuits. In early youth he became interested in astronomy, dating from his first view of a total eclipse of the moon seen by him when a boy eight years of age. Later on he came across a copy of Burritt's Star Atlas, with its fascinating combinations of stars interwoven with mythological figures, and poring over these by day, and tracing out the constellations by night, he gradually attained a general knowledge of their position and outlines. Then he attended a course of lectures on astronomy given by the writer's father, the late Richard A. Proctor, and from that time his enthusiasm was fully aroused. He started the foundation of an astronomical library, and also purchased a Byrne five-inch objective. He fitted out the entire upper story of his spacious Colonial residence on Adams Street, Los Angeles, as an observatory and workroom for the unrestricted use and occupation of the Astronomical Section of the Southern California Academy of Sciences, of which he has been a member almost from the date of its organization.

He has designed what he terms an electro-transparency, illuminated with sixteen electric lights, by means of which he obtains a brilliant display of enlarged views of photographs taken with the 60-inch reflector at Mount Wilson. Becoming profoundly impressed with the work accomplished by this telescope, he became imbued with the desire to furnish the means for a reflector which would emulate the performances of the 60-inch. If a 60-inch reflector will accomplish more than has been done by the Crossly reflector at the Lick Observatory on Mount Hamilton, what will a 100-inch mirror disclose? The construction of such an instrument would be the work of a comparatively short time, and enthused with the idea, Mr. Hooker entered into communication with the Carnegie Institution at Washington. He offered to give the sum of fifty thousand dollars for the manufacture of a 100-inch reflector. The proposition was accepted, and there was no delay in prosecuting the work.

The order for the casting of the glass disk was given in September, 1906, to the French Plate Glass Companies at St. Gobain, France, and during the year between the spring of 1907 and June, 1908, six or eight castings were made. In order that there might be no delay in the grinding, polishing and figuring the disk after its arrival, Mr. Hooker constructed at Pasadena, in the winter of 1907, a building which he supplied with all necessary appliances. The main room is 24 feet square and 20 feet high, and opens into a long testing hall.

"The walls of this room are very heavy, made of brick laid in cement, and covered with a roof of reinforced concrete. This portion of the building, which is separated from the other part by iron doors, may therefore be regarded as fire and earthquake proof—a consideration of no small importance in view of the nature of the work to be done within its walls. A heavy steel beam, supported over the doorway, carries a traveling crane, by means of which the mirror disk and heavy parts of the grinding machine, one of which weighs 3.5 tons, can be brought into the room and handled when necessary during the progress of the work. The testing hall, 100 feet long and 10 feet wide, will permit the mirror to be tested from the center of curvature or with parallel light. On one side of the testing hall are rooms for the grinding and polishing tools, and for the apparatus required to maintain the polishing room at a uniform temperature. There is also a large fireproof vault, for the storage of astronomical photographs. On the other side of the hall a series of computing offices is provided, affording with the rooms already available in the adjoining building, suitable accommodations for a large staff of computers." (Annual Report, 1907, of Prof. G. E. Hale, Director of the Mount Wilson Solar Observatory of the Carnegie Institution of Washington.)

In June, 1908, information was received at Los Angeles from the glass companies at St. Gobain that the casting of a perfect disk 102 inches in diameter, 13¼ inches thick, and weighing 4½ tons had been successfully accomplished. On December 2nd, 1908, in its iron case, it reached the end of its long journey, and was deposited in the Hooker building at Pasadena, but upon being unpacked it was immediately seen that the lens was imperfect and did not fulfill the conditions of the order.

Prof. G. W. Ritchey of the Mount Wilson Solar Observatory was instructed to proceed at once to France and secure the casting of a perfect disk which has not yet been completed. Meanwhile an attempt is at present being made to bring the rejected mirror first sent up to the necessary point of perfection, and the writer saw the polishing process actually under way during her recent visit to the laboratory at Pasadena. It is estimated that the expense of the mounting, dome and building will amount to several hundred thousands of dollars in excess of the original gift of fifty thousand so generously donated by Mr. Hooker, but it is his intention to carry the project through to ultimate success.

Furthermore, in the interests of astronomical research, Mr. John D. Hooker paid the expenses necessary for the transportation of the Bruce Observatory telescope, in 1905, from Williams Bay, Wisconsin, to the summit of Mount Wilson, California, so that its wonderful powers of definition might be utilized to their fullest extent as far as photographing the Milky Way, clusters and nebulæ is concerned. The work was successfully accomplished by Prof. E. E. Barnard of Yerkes Observatory, and the result is now being compiled in book form by the Carnegie Institution. The scientific world is indebted, however, in this case as in the instance of the 100-inch mirror, to the generosity of Mr. John D. Hooker which made the accomplishment of the work possible.

The following tribute of appreciation was written May 25th by Prof. G. W. Ritchey, of Mount Wilson Solar Observatory:

"In the death of Mr. John D. Hooker of Los Angeles, not only the Mount Wilson Observatory, but the entire scientific world loses one of its most generous friends and benefactors. It is quite certain that had it not been for Mr. Hooker's enthusiasm and generosity, the 100-inch Hooker telescope, a photographic telescope of unprecedented size, which is now under way in the observatory shops, would not have been undertaken.

"In his love for science, Mr. Hooker had the vision of a prophet as well as the keen practical sense of a great man of business. He appreciated the vast aid and advantage which could be brought to his beloved science of astronomy by the use of photography, and he determined to supply that aid by providing for the construction of the largest and most perfect photographic telescope which the present development of glass making, of optical work, and of mechanical engineering would allow.

"Mr. Hooker watched with the keenest interest the process of the work upon this telescope—the grinding and polishing of the 100-inch glass, and the designing of the great telescope mounting and its protecting building. It is a matter of profoundest regret to all of us who have associated with him in his work that he could not have lived to see its completion, and to see the incomparable celestial photography which it will make possible. But the work will go on and bear his name."

Identification of Dye Woods

THE Forest Service has just issued a very practical publication dealing with the structural characteristics of true fustic wood (*Chlorophora tinctoria*, Gaud.) and its substitutes and adulterants in the use of making dyes. The circular considers only true fustic and three of its most common substitutes, leaving untouched the groups of other woods employed in making dye extracts. The study on the identification of other important dye woods by George B. Sudworth, Dendrologist, and C. D. Mell, Assistant Dendrologist, will be continued and the results published in a series of papers illustrating the need of closer inspection of the dye woods of commerce. Great pains and no little ability have been used in presenting the facts of this new and technical subject in such language as will be understood by all intelligent laymen. Where technicalities are used definitions and illustrations are given or the context explained so that the average person will readily understand them. The authors give a key which will enable the "man in the street" to identify the woods commonly substituted for fustic. The illustrations of magnified transverse sections of the wood show the characters which will help the reader to recognize the woods considered. Students of forestry, as well as timber merchants, will not only find this circular very instructive, but also illustrative of a new and interesting type of government publications. The circular begins with a brief general consideration of the properties and uses of the woods together with a list of their common trade names. The remaining space is devoted to a detailed description of the minute structural elements in the wood of true fustic. This paper is the first contribution to the literature dealing with the subject of substituting inferior woods for a standard kind, and it may be cited as an excellent monograph of a small group of such substitutes.

New Aeroplane Speed Records in France

IN an official try-out of his 140 horse-power Gnome-engined Blériot monoplane on June 12th, with a view to being selected as one of the French team in the Bennett cup race in England on July 1st, Alfred Leblanc flew 150 kilometers—93.2 miles—which is the full distance to be flown in the race proper, in 1 hour, 18 minutes and 35 seconds, corresponding to an average speed of 71.16 miles an hour. Four days later, M. Nieuport, in a similar test, covered 145 kilometers—90.9 miles—at the rate of 80.15 miles an hour, according to the cable dispatches. Both tests were made over a 3.1-mile circular course.

By covering 100 kilometers in 48:58 (76.12 miles per hour), Leblanc lowered by 1 minute, 38 seconds Nieuport's previous record. He covered 125 kilometers (77.67 miles) in one hour, the fastest record for this distance. Le Martin is reported to have made one circuit with the Blériot racer in a private test at the rate of 93.2 miles an hour.

J. Armstrong Drexel may represent America in the international race with a Blériot racer, and Charles T. Weymann with a Nieuport.

New Cloud Atlas.—A new edition of the "International Cloud Atlas," the publication of which has been delayed for several years by financial and other obstacles, has just appeared. Subscriptions to this work, which sells at ten francs, are being received by M. Léon Teisserenc de Bort, Observatoire de Météorologie Dynamique, Trappes, France.

Longer Piers for Giant Steamships

Arrival of the 882 1/2-foot "Olympic" at New York

THE arrival of the 60,000-ton displacement "Olympic" of the White Star Line at the port of New York emphasizes the necessity for building longer piers to provide proper docking facilities for ships of this size, of which undoubtedly a considerable number will be built during the coming decade.

It is due to the timely agitation of this subject and the broad-minded policy of the War Department that the "Olympic" is able to tie up at a White Star pier. The ship is 882 feet 9 inches in length on deck; yet three months ago the longest pier of the White Star Company was but 800 feet in length, and the longest piers of any kind on the Manhattan shore line, those of the Cunard Company, were but 825 feet in length. Had no provision been made for lengthening her pier, the stern of the "Olympic" would now be projecting some 90 feet into the fairway of the North River, where her propellers, rudder, etc., would be in constant peril of disablement by passing craft.

The pier head lines of the ports of the United States are determined by the Board of Engineers of the army, who have charge of the nation's interest in all matters affecting the physical side of our rivers, harbors, channels, waterways, etc. It is their duty to see that these national properties are not injured by the encroachment of private interests, whether corporate or personal, and to prevent the extension of piers unduly into rivers and channels, or the obstruction of the latter by bridges and other structures. The army engineers have been exceedingly faithful in their guardianship, and when it was proposed to extend the New York piers 100 feet to accommodate the longer ships of the present day, they strenuously opposed the movement on the ground that it would constitute an obstruction to navigation, reducing the navigable width of the North River by 100 feet, and to that extent increasing the congestion in an already rather crowded fairway.

Various influential interests in New York, including the steamship companies and several commercial bodies, urged upon the government the wisdom of making the desired pier extension, pointing out that the Hudson River had considerably the greatest width of channel between pier head lines of any of the leading ports of the world, the clear width being for the Hudson River at New York 2,750 feet; River Mersey at Liverpool, 2,000 feet; River Thames at London, 1,600 feet, and for the River Elbe, at Hamburg, 1,200 feet.

By way of compromise, the Secretary of War gave permission for the lengthening of the piers by 100 feet. The important proviso was made, however, that the extension must be of temporary character, and built of such open construction that the river current could flow freely through it. Moreover, the permit was made merely for the extension of the pier and not for the pier shed. The structure was to be removed within a period of eighteen months.

On the front page of this issue will be found a bird's eye view of the White Star pier as lengthened under this permit. The extension consists of clusters of piles capped and sway-braced, with planked runways for the use of the dock crew in handling the mooring and warping cables. It will be noticed that even with this 100-foot extension the pier overlaps the stern of the "Olympic" only by a few feet; sufficient, however, to give her ample protection against collision from passing vessels.

By way of illustrating the remarkable growth of the ocean ship, our artist has shown two other large liners, one of which, the "Oceanic," at the date of her appearance, excited even more attention on account of her size than has the "Olympic" itself. Lying abreast of the "Olympic" is the "Finland," of the old American Line, herself a vessel of no mean proportions. She is 580 feet long, 60 feet broad, and 42 feet in molded depth. In the adjoining basin, on the opposite side of the pier shed, is shown that famous vessel, the "Oceanic," the first ship to exceed a total length of 700 feet, and the first vessel to surpass in length the "Great Eastern." The "Oceanic" is 704 feet long on deck and 68 feet broad.

In a succeeding issue we shall give further particulars and illustrations of the "Olympic." It is sufficient here to give the leading particulars.

Length over all	882 feet 9 inches
Length between perpendiculars	850 feet
Breadth, extreme	92 feet 6 inches
Depth, molded, keel to top of beams, bridge deck	73 feet 6 inches
Total height from keel to navigating bridge, about	104 feet
Gross tonnage	45,000 tons
Load draft	34 feet 6 inches
Indicated horse-power of reciprocating engines	30,000
Shaft horse-power of turbine engine	16,000
Speed	21 knots
Displacement	30,000 tons

It takes but a glance at our front page engraving to show that not merely in the matter of length of pier, but also in that of width of basins, the steamship companies, if they continue to increase the size of ocean liners, will be confronted with a perplexing problem. If the "Titanic," a sister ship to the "Olympic," were moored in the same basin, say, in the place of the "Finland," it would be difficult, if not impossible, to coal the ships at the same time. Certainly a string of coal barges could not lie alongside the two ships simultaneously, nor could empty barges be towed out and full barges brought in. It is evident, therefore, that a point has been reached, at least in the history of the port of New York, where the whole question of dock accommodation will have to be taken up anew, and a system of new docks laid out on a scale which will provide adequately for the inevitable growth of ocean liners of the largest size. A thorough study of this subject has been made by the present Dock Commissioner, Calvin Tomkins, and in the mid-month magazine number of the SCIENTIFIC AMERICAN, which will be published on July 15th, there will appear an article from his pen, dealing with this important question.

Correspondence

The Preservation of Niagara Falls

To the Editor of the SCIENTIFIC AMERICAN:

At the head of the editorial columns of your publication I note that it is declared that "The purpose of this journal is to record accurately and in simple terms the world's progress in scientific knowledge and industrial achievement." Immediately following this declared purpose, in your issue of May 27th, you publish an editorial entitled "Niagara Falls Again Threatened."

The writer has resided a lifetime in proximity to the great Falls of Niagara, has witnessed the electrical power development from the beginning, is familiar with every detail of it, and confidently asserts that the diversion of the waters of the Niagara River for power development purposes has made absolutely no perceptible difference in the flow of the river. The only difference that has been seen in the river has been caused by the changes in the direction of the wind, by ice jams for a few hours in the winter, and by high and low water conditions that are periodical and are common to all lakes and streams. Sometimes Lake Ontario washes its banks and sometimes there are many yards of beach. In corroboration of my statement that the power development has made no perceptible difference in the flow of the river, I bring official testimony. In the early summer of 1908 the two power company plants in this city were entirely shut down for several hours, and a test was made by United States engineers to ascertain the effect upon the flow of the river over the Falls. In a letter to the *Engineering News* of July 2nd, 1908, Major Charles Keller, Corps of Engineers, United States Army, officer in charge of lake survey, said that during the period of the shutdown "The rise shown by the gage set by the lake survey close to the crest of the American Fall was about an inch, and was fully as much as anticipated." Another test about the same time was officially reported by G. Edward Wilson, secretary of the American section of the International Waterways Commission, as 46/100 of an inch. The Burton law was in effect then, it is in effect now, and Niagara Falls is not "threatened" any more now than it was then. In fact, a treaty between the United States and Great Britain has since been ratified which permits the diversion of 20,000 cubic feet per second of water on the American side and 36,000 cubic feet per second of water on the Canadian side. This provision was in accordance with the recommendation of the International Waterways Commission, which thoroughly investigated the subject. The present diversion on the American side of the river is 15,600 cubic feet per second of water, so that there is still a leeway of 4,400 cubic feet per second of water under the limitations of the treaty. Before the present permits were granted under the Burton law that went into effect June 29th, 1906, William H. Taft, then Secretary of War, came to Niagara Falls and gave a hearing to all parties interested. In granting the power permits, Secretary Taft promulgated a lengthy opinion, in which he said:

"The International Waterways Commission, a body appointed under a statute of the United States to confer with a similar body appointed under a statute of Canada, to make recommendations with reference to the control and government of the waters of the Great Lakes and the valley of the St. Lawrence, have looked into the question of the amount of water which could be withdrawn on the American and the Canadian side of the Niagara River without substantial injury to the cataract as one of the great natural beauties of the world, and after a most careful examination they have reported, recognizing fully the necessity of preserving intact the scenic grandeur of the Niagara Falls, that it would be wise to restrict diversion to 28,600 cubic feet per second on the American side of the Niagara River, and to restrict the diversion on the Canadian side to 36,000 cubic feet a second."

Later the British-American treaty provided for a diversion of 20,000 cubic feet per second of water on the American side and 36,000 cubic feet per second of water on the Canadian side. My information is that the present diversion is 27,000 cubic feet per second of water. Your statement is that it is 34,000 cubic feet per second of water. In the opinion referred to above, Secretary Taft continued:

"I have already said that the object of the act is to preserve Niagara Falls. It is curious, however, that this purpose as a limitation upon the granting of permits by the Secretary of War is only specifically recited in reference to his granting permits for diversion of additional amounts of water over 15,600 cubic feet on the American side, which are to be limited to 'such amount, if any, as in connection with the amount diverted from the American side, shall not interfere with the navigable capacity of said river or its integrity and proper volume as a boundary stream, or the scenic grandeur of Niagara Falls. This peculiarity in the act is significant of the tentative opinion of Congress that 15,600 cubic feet of water might be diverted on the American side and 160,000 electrical horse-power might be transmitted from the Canadian side without substantial diminution of the scenic grandeur of the Falls." And then Secretary Taft gave his decision that "Acting, however, upon the same evidence which Congress had, and upon the additional statement made to me at the hearing by Dr. John M. Clark, State Geologist of New York, who seems to have been one of those engaged from the beginning in the whole movement for the preservation of Niagara, and who has given close scientific attention to the matter, I have reached the conclusion that with a diversion of 15,600 cubic feet on the American side and the transmission of 160,000 horsepower from the Canadian side, the scenic grandeur of the Falls will not be affected substantially or perceptibly to the eye."

That is the diversion that is taking place to-day. It was the judgment of the International Waterways Commission and the men who framed the British-American treaty that an even greater diversion would not be injurious. It was the opinion of the Congress of the United States and Secretary Taft that the present diversion would not be injurious. A test made by engineers of the United States Lake Survey Corps proved that the diversion is not perceptible, and we who see Niagara River daily say that no effect on its flow is seen as the result of power development. There is now being developed from the Falls of Niagara 350,000 electrical horse-power. Their total power producing capacity is estimated at from 5,000,000 to 7,000,000 horse. Do you think the cataracts as a spectacle are seriously threatened? C. T. WILLIAMS,

Niagara Falls, N. Y. City Industrial Agent.

Liquid Slag from Producers

AT the experiment station of the United States Bureau of Mines, Pittsburg, Pa., trial runs have been made with a gas producer using coke as fuel, with which limetone has been mixed in varying proportions, the purpose being to flux the ash and form a liquid slag, thus avoiding clinker and ash troubles, and consequent shut-downs.

Dynamite as a Railroad Builder

High Explosives as One of the Principal Agents in the Building and Reconstruction of Our Railroads

By Willard Young

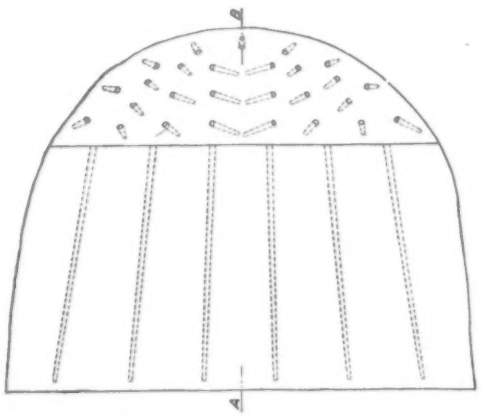
NOT many people besides railroad engineers and dynamite makers know that the improvement in blasting explosives during the past two decades has been one of the principal factors in making possible the fast and comfortable trains now running on almost every railroad. Yet this is an indisputable fact; for the straightening of the railroads which has been carried on so industriously for several years has lessened the time for trains running at the same speed as formerly, as well as the distance between stations. Again, the straightening, combined with leveling, has made it possible to run trains with safety at a greatly increased speed. Heavier and more substantial cars can be used, and the decrease in curves and grades reduces the wear and strain so much on rolling stock that it does not need to be repaired or replaced so often. The money thus saved can be used for more comfortable and luxurious equipment, and for running trains more frequently. No matter how well constructed the road bed or how perfectly built the car, the surge and jolt when rounding short curves, the long, jolting drag up heavy grades and the rush down with intermittent application of air brakes, is as wearing on the body and nerves of the traveler as it is on the car and the track.

When many of the railroads were first built, high explosives were expensive and uncertain. Only one or two kinds were known, and instead of being able to secure a different one especially adapted to almost every particular kind of rock which is encountered, as is possible to-day, it was necessary to do all kinds of blasting with practically one kind of dynamite. Naturally this dynamite was not suitable for much of the blasting, and its use would have made the cost often prohibitive. This was one of the reasons why, instead of tunneling through the mountain as is done to-day, the railroads wound tortuously over or around.

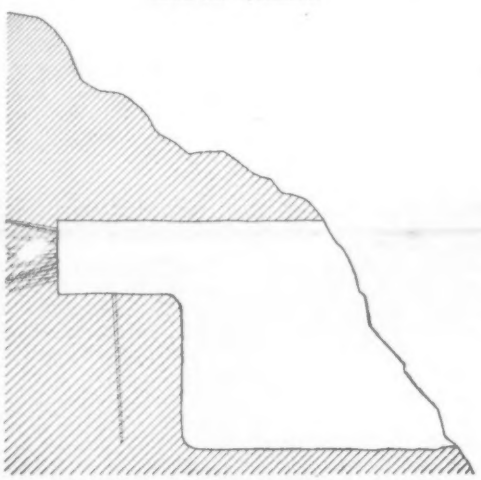
In railroad building and the railroad shortening now done, tunnels are bored for miles through the mountains much nearer to their base, great open cuts are made through the hills, one-third or one-half way up their sides, and the rock and earth taken out is used to fill up to approximately the same level a road bed across the adjoining valleys. Instead of curving all the way around the spurs of mountains and of hills, railroad builders cut them partly away.

None of this boring and slicing through rock can be done economically without dynamite. It would take twenty-five to thirty carloads of dynamite to blast a double track railroad tunnel a mile long. Much less dynamite is required for the same yardage in open work.

Railroads and all other tunnels more than six or eight feet high are driven in two sections, one above the other. The upper section, called the heading, is started first and always kept a number of yards in advance of the lower section or "bench." This practically divides the tunnel into a smaller tunnel, six or eight feet high, and as wide as the upper part of the main tunnel, and a "thorough cut" represented by the "bench." It is more economical and convenient to drive a tunnel in this way than it would be to attempt to carry forward the entire face at once. In the first place it provides a solid foundation and footing for the drills and men boring the holes for the explosives in the upper part. Again, by taking out the upper section first, two free faces are provided when blasting the lower part, and less explosives are required when two faces are open than when only one is exposed as in the heading.



Face of heading and bench, showing position of bore holes for dynamite.



Longitudinal section through railroad tunnel, showing bore holes for blasting.

The holes in the heading for the explosives are usually drilled six or seven feet deep and each is charged with from three to six pounds of blasting gelatin (100 per cent) and 50 per cent or 60 per cent gelatin dynamite. First a wedge shaped section extending from the bottom to near the top is blasted out, two vertical rows of holes being drilled for the purpose. These holes, which are called the "cut" holes, are several feet apart at the mouth, but converge until they almost meet at the points. Next two or four more rows are drilled outside of these, which serve to widen the wedge when they are blasted. These are the relief holes. The "round" is completed by the "side" or "rib" holes near the sides and the "top" holes across the top, this row of holes being started on a line following approximately a foot or so inside of the finished line of the tunnel, and pointing slightly outward and upward. The exact number of holes required for each round of the heading is governed by the size and shape of the tunnel and the nature of the rock. To blast the "bench," a row of holes is drilled straight down into it parallel to the face and several feet back of it, and sometimes another row, almost straight into the face across the bottom. Each of these is charged with two to four pounds of 40 or 50 per cent gelatin dynamite. Gelatin dynamite is always used in tunnels because it does not give off objectionable fumes when exploding, and is highly waterproof. Tunnels are often very wet and the ventilation is necessarily limited.

Railroad cuts, if they are deep ones, are blasted in benches, the depth of these benches depending on the kind of drills with which the holes for the dynamite are bored. When well drills are used, the holes are generally bored forty or fifty feet deep and twenty or thirty feet apart. These holes are often charged with several hundred pounds of dynamite, Judson powder or blasting powder, the quantity and kind of explosive being governed by the depth of the bore holes, character of the rock and other local conditions. When the blasting is carried on in cold weather the 40 per cent grade of low freezing dynamite is generally used unless the rock is so soft and the work so dry that blasting powder will be satisfactory. When holes are bored with ordinary rock drills, the system of blasting is much the same. The holes, however, are not often deeper than twenty feet, are spaced six to ten feet apart, and are charged with a much smaller quantity of explosives. The first cut on each level, when the railroad is to run through a hill, has but two free faces, the top and front, and is commonly called the "thorough cut." The succeeding cuts on each level, which are made for the purpose of widening the original cut, are known as "open" or "side hill" cuts, and having three faces free, require less explosives per yard of cut than do thorough cuts.

It is sometimes more economical to blast away all of a short spur running across the right of way than to make a thorough cut through it or to swing around it. In this case the spurs are disposed of by exploding a very large charge—often several thousand pounds—of Judson powder, blasting powder or dynamite, under them. To get the dynamite into the proper position, small tunnels, often with cross headings or chambers, are driven into the spur and in these are packed the explosives. The blast in work of this kind is usually very spectacular, though it does not often make a great deal of noise or shock at any considerable distance away.

A big blast in a heavy railway cutting.

DYNAMITE AS A RAILROAD BUILDER

Catskill Water Supply Tunnel Below the Hudson River

How the Aqueduct Will Make an 1100-foot Dip Below the Gorge

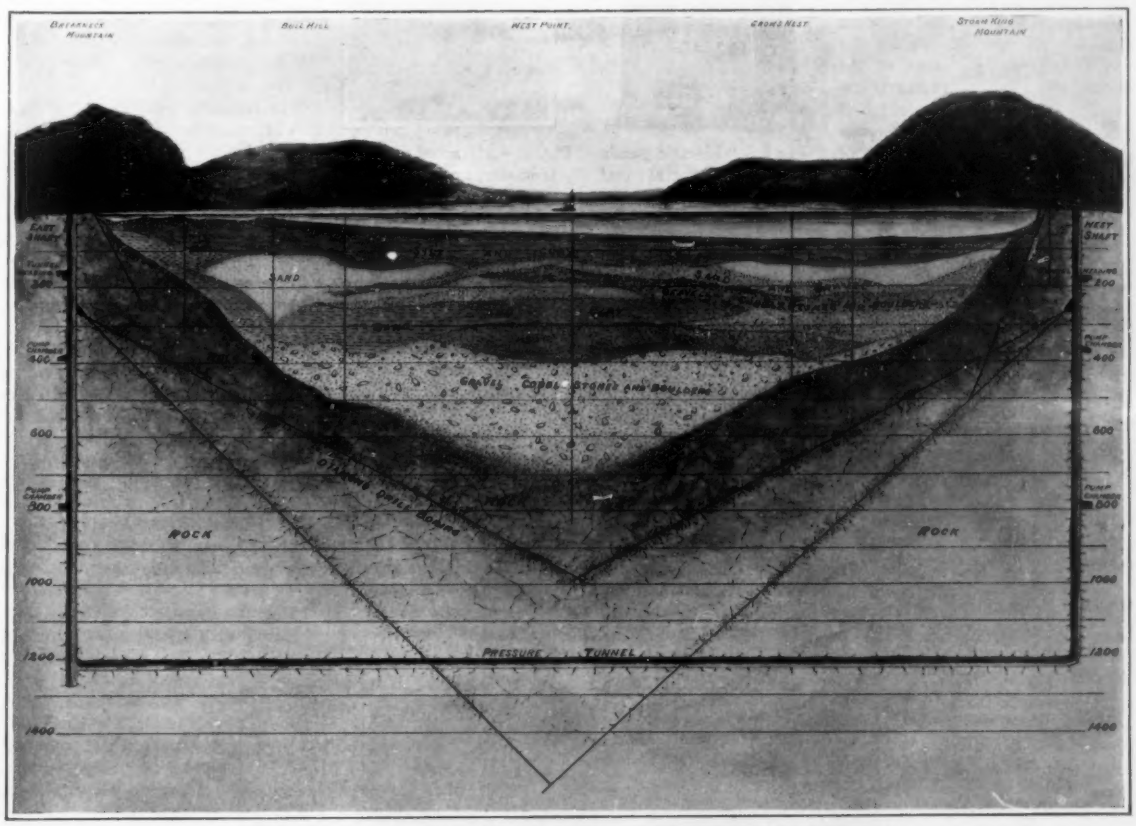
THE construction of the reservoirs and aqueduct for bringing a daily supply of five hundred million gallons into New York from the Catskill Mountains has involved engineering work of great magnitude, and in some cases of considerable perplexity and difficulty. As it turned out, the most serious problem was encountered at the Hudson River, where the engineers had to determine upon the best method for conducting the water past that great natural obstacle.

Four alternative plans were considered; first, to lay steel pipes in trenches dredged across the river bottom; second, to drive a tunnel through the glacial deposit in the river bottom; third, to carry the aqueduct across the river upon a bridge; and lastly, to build a huge inverted siphon at a depth sufficient to bring it entirely within the solid underlying rock. The last was the plan adopted.

To determine the depth and character of the rock, fifteen vertical holes were drilled from the surface of the river, and two inclined holes, of different degrees of inclination, were driven from each shore. Six of the vertical holes reached bed rock, and one of them in the center of the river reached an ultimate depth of 768 feet, when it had to be abandoned without reaching bed rock. This boring developed the fact that the present Hudson River flows in an old glacial gorge which has been filled up with deposits of silt, sand, gravel, clay and boulders to a depth of over 800 feet.

Now it was realized that a deep-pressure tunnel, to be perfectly reliable, must lie in absolutely sound and unfissured rock; and since it was impossible to test the rock by vertical borings made from scows anchored in the river, the engineers determined to explore the underlying material by means of inclined borings driven from either shore. Accordingly, two shafts were sunk to a depth of between two and three hundred feet, and from them two diamond drill borings were started, which ultimately crossed at a depth of 1,500 feet below the surface of the river. A good rock was found at that level. To make the survey more reliable, a second pair of holes was drilled at a less inclination, which crossed at a depth of 950 feet below the river surface. The rock was found to be perfectly satisfactory, and such water as was found was limited in extent and due to well-understood geological causes.

It was therefore determined to sink the east and west shafts to a depth of from 1,150 to 1,200 feet below ground surface, and connect them by a tunnel 3.022 feet in length at a depth of 1,100 feet below the river surface. The shafts have been sunk, that on the West Shore to 1,153 feet, the East Shore shaft to 1,187 feet, and the boring of the tunnel toward the center of the river has made good progress, the easterly section having advanced at the present writing about 260 feet, and the westerly section 170 feet from their respective shafts. Both the shafts and the tunnel will be lined with a high grade of Portland cement concrete, which will give them a finished internal diameter of 14 feet. The aqueduct reaches the Hudson River at an elevation of 400 feet above mean water level. Hence the total head of water is about 1,500 feet, and the total pressure on each square foot of the tunnel is about 46½ tons, which is balanced with a wide margin of safety by the weight of the superincumbent mass of rock, silt and water.



This huge syphon, 14 feet in diameter, will carry the 500 million gallon per day water supply for New York beneath the Hudson River at a depth of 1,100 feet.

CATSKILL WATER SUPPLY TUNNEL BELOW THE HUDSON RIVER

Audibility of the Aurora

NO question in connection with the aurora polaris has been more discussed than that of the sounds said sometimes to accompany this phenomenon, and usually compared to the rustling of silk, cracking, hissing, whizzing, etc. A majority of the scientific observers of the aurora have never heard these sounds. Tromholt, one of the most careful students of auroræ, says in his book, "Under the Rays of the Aurora Borealis":

"Without absolutely refusing to believe in the possible existence of such a sound, I fancy that there must be some acoustic deception or misunderstanding which has created this belief in an auroral sound. During my stay at Koutokæino I was daily surrounded by people who believed as firmly in the sound as in the Holy Gospel, yea, at Bossekop they even told me that they did not think there was any aurora borealis at all until it whizzed; and still I maintain that of all the intense auroræ I have observed in various parts of the Arctic regions, and which I am sure I have watched with more attention than is generally bestowed on them, every one has been perfectly silent."

These words represent the attitude of most writers on the aurora to the question of its audibility. Angot points out that the possible causes of erroneous observation are very numerous; the observer may be tempted to attribute to the aurora many sounds that have nothing to do with it, a principal one in the polar regions being the incessant crackling of fields of snow, and the faint sounds that accompany the formation of small needles of ice on clear, cold nights. On the other hand, the supposed sounds have also been explained as subjective phenomena—the "phonisms" of the psychologists—the brilliant light of the aurora suggesting the sensation of sound by a kind of synæsthesia, the converse of the process known as "colored audition."

There remains, however, much evidence to contradict these attempts to explain away the sounds of the aurora, and one of the most convincing cases heretofore reported in support of the other side of the controversy was embodied in a recent letter to the secretary of the Royal Astronomical Society of Canada from Mrs. George Craig, who writes from Dawson, Yukon Territory, under date of March 21st, 1911:

"About 1:30 A. M., on January 26th, as Mr. Craig and I were returning home after spending an evening out, we were startled by unusual sounds, seemingly from above us. We were not *looking* for auroral displays, as the temperature was about 50 deg. below zero (much too cold for indulging in astronomical observation), and were scurrying home with heads bent down into our fur storm collars, and with no thought of anything except the desirability of reaching our own fireside as quickly as possible.

"We were arrested by strange sounds, like the swishing and brushing together of particles of finely-broken glass. The sound came in great waves, passing slowly backward and forward over the auroral arc. Sometimes the wave, with its musical tinkling, would almost seem to surround us; then it would recede so far as to be almost inaudible. Then again it would come nearer, and then drop down quite near to us, and then recede again up high overhead. For the most part, however, the wave traveled back and forth regularly over the auroral arc nearest to us.

"Our '50 below zero' mist enveloped the heavens and the earth, but, as far as we could see, there were no 'streamers' and no 'corona'; merely two pretty, well-defined arcs.

"I may mention that we were crossing the park at the time we first heard the sounds, and everything was as near absolute silence as could well be. . . . I am told that a Mr. W. H. Wright, of Dawson, reported having heard the same sounds on the same morning at 3 A. M."

Mrs. Craig states further that during her eleven years' residence in the Yukon, though she had seen many splendid displays of the aurora, she had never before heard anything approaching a sound coming even from the brightest of them.

The South Sea Swells

WE all remember with what frequency in the old narratives of experiences in the South Seas reference is made to the heavy swells of the ocean, which impressed the navigators with the idea of their remoteness from land.

The great size of the sea waves in high southern latitudes has been explained by the fact that south of the Cape of Good Hope and Cape Horn there is neither windward nor leeward shore, and the prevailing wind in all longitudes is westerly. Thus when a west wind springs up it finds a long westerly swell, the effect of a previous wind, still running. The new-born wind increases the steepness of this swell, and so forms majestic storm waves, which sometimes attains a length of twelve hundred feet from crest to crest. The average height attained by sea waves in feet is about half the velocity of the wind in miles per hour.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Illustrations and Applications of Electric Tension

THE German periodical *Die Welt der Technik* reproduces some very readable and cleverly illustrated passages from a recent book, "Entdeckungsfahrten in den elektrischen Ozean," published by Prof. A. Slaby, of Berlin, the well-known wireless telegraphy expert.

The first experiment to which the author draws attention is designed to demonstrate the fact that the poles of a battery on open circuit carry charges quite similar in their action to those observable upon a material which has been rubbed to electrify it. As shown in Fig. 1, two disk electrodes form the terminals of a secondary battery, and between them is delicately suspended a piece of fine aluminium foil. The whole is covered with a glass bell to protect it from air currents. Under these circumstances the aluminium foil is seen to be first attracted toward one of the disks (the one which happens to be nearest), owing to the gathering of an induced charge upon it, which is opposite in sign to that of the inducing electrode. As soon, however, as the foil touches the electrode it receives by conduction a charge of the same sign as that of the disk, and is instantly repelled, and flies to the opposite electrode, to which it gives its charge, at the same time receiving now a new charge of the opposite sign. This succession of events is repeated indefinitely, the foil swinging to and fro like a pendulum. In this way the battery is very slowly discharged.

The state of affairs which exists at the poles of a battery is commonly described by saying that there is a difference of potential, or an electric tension between them. For the purposes of practical applications of electricity it is necessary to have some measure of this tension. The idea naturally suggests itself to use the attractive force between the two poles to measure this tension, and this is in fact one of the methods employed to measure difference of potential. An electro meter built on this plan is shown in Fig. 2. To measure the difference of potential between two points, such as the poles of a battery, the one is connected to a fixed plate, and the other to a movable disk suspended above the first. There is thus produced an attraction between the two disks, and the amount of this may be indicated directly by a pointer, as in a letter scale, or may be determined by means of a counterpoise weight.

An effect of electrostatic tension which makes itself felt in various ways is its influence upon the condensation of liquids from vapors and from small drops into larger drops. To this action is, for instance, due in part the refreshing clearness of the air which is felt after a thunderstorm. This is not due merely to the washing down of the dust by rain, but at least in part also to the condensation of moisture upon dust nuclei, which are in this way carried to the ground. The condensing action of a field of electric tension can be shown experimentally by means of a fountain. Ordinarily this presents the appearance shown in Fig. 3, the water falling back in a fine spray. But on bringing up for example an electrified ebonite rod the water is seen to gather into large beads (Fig. 4). It has been proposed by Sir Oliver Lodge to make use of this phenomenon for the purpose of laying the very troublesome dense fogs which periodically engulf London and other cities of England. Prof. Slaby has also carried out experiments on smoke abatement, using the apparatus shown in Fig. 5. A turpentine lamp is burnt beneath a hood, and the dense black smoke thus produced is allowed to pass up a tall stovepipe in which are placed two terminals connected to a high tension circuit. It was found that in this way every particle of the soot formed could be condensed at the bottom of the pipe. At fire sight this appears to be a most desirable achievement, for the smoke thus condensed is of course unburnt fuel, and as such of considerable value. Unfortunately, the cost of the operation is found to be out of proportion to the values recovered. The same objection is the cause of Sir Oliver Lodge's failure to cope with the fog situation in a practical way.

It does not necessarily follow, however, that experiments of this kind must remain quite fruitless. For certain special purposes of industry electrical condensation may be found practicable.

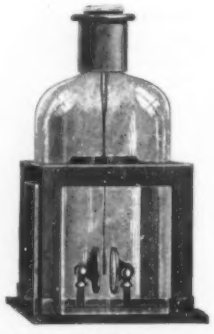


Fig. 1.—"Electric pendulum." A metal leaf oscillates between the terminals of a battery.

Fig. 2.—Attracted disk electrometer, an instrument for measuring differences of potential.

Fig. 3.—A fountain of water under ordinary conditions.

Fig. 4.—The same fountain under the influence of an electric field.

Fig. 5.—Slaby's apparatus for condensing smoke.

Mathematics and Medicine

IN an article with the above heading in *Arms and the Man*, Capt. Louis C. Duncan, Medical Corps, United States Army, says: "I believe it was stated that the death rate for operations on abdominal wounds in the Cuban war was 100 per cent. But an examination of the data showed but three such wounds, and they not operated on in the field. At any rate it should be obvious that no valuable conclusion could be drawn from so few as three cases. It is stated that in our civil war there were four times as many deaths from disease as from bullets; while in the Spanish war there were twelve times as many. The obvious conclusion of the average reader is that there was three times as much disease and death in the latter war as in the former. This conclusion is entirely false, the fact being that there was more than twice as much disease and deaths from disease (proportionately) in the civil war as in the Spanish war. Again, it is stated that in the Boer war the British lost twice as many men by disease as they did by bullets, while with the Japanese in the Russian war the ratio was precisely reversed. What is the conclusion? Why, that the British losses from disease were four times those of the Japanese, and reasoning still farther it is proclaimed that the Japanese sanitary arrangements must have been far superior to the British. Again, all this reasoning is fallacious and the conclusions false. The British losses were no greater than the Japanese. The Japanese had as much or more disease than the British.

"In a series of articles recently written by an imaginative gentleman (Gen. Homer Lea), and since published in book form under the title 'The Valor of Ignorance,' this fallacious reasoning reaches the very height of absurdity. The statement is actually made in all seriousness that there were fifty-six times as many deaths from disease (proportionately) in our army in 1898 as there were in the Japanese army during the recent war with Russia. Here are the words: 'In the Spanish war fourteen men died of disease to one on the battlefield. In the Japanese army during the Russian war four deaths resulted from bullets to one from sickness.' 'In a war between Japan and the United States, . . . should the ratio remain the same, . . . the American losses from disease would be 700,000, as against 12,506 Japanese.' The colossal error of this ill considered statement should be apparent to the most simple. Yet it is published in a well-known journal and then spread broadcast in book form, apparently uncontradicted. Possibly the whole thing is considered fiction, but this statement, reflecting in the gravest manner on our army, and more pointedly on the medical department of it, is put down as a fact. To show the supreme absurdity of it let us reverse the problem. Let us say we had one-fourteenth as many deaths from wounds as from disease in 1898. The Japanese had four times as many deaths from wounds as from disease; therefore they had fifty-six times as many deaths from bullets as we, Q.E.D. And in a war between us we should get off with but 12,500 killed, while the poor Japanese would lose 700,000. Ridiculous, of course; but not an iota more so than the other.

"The fallacy in both cases lies in using a variable quantity, or, worse, two variable quantities, as a standard of comparison. Use a fixed quantity—1,000 men in service one year—as the standard, and this error disappears. If we use this, the only logical standard of comparison, we learn that the record in 1898 was not fifty-six times as bad as that of our Oriental friends in 1904-5; it was not ten times as bad; it was not even twice as bad. The actual facts are that the American death rate from disease in 1898 was about twenty-five per 1,000 per annum, while the Japanese rate was between twenty-five and thirty. Their rate was no better than ours. But that is not all. In the year 1899 we had a considerable army in the Philippine Islands; that is to say in the tropics, which had always been death traps for armies. Compared with these islands Manchuria is by all reports a health resort. Col. Harvard says it is one of the healthiest countries in the world. Yet our loss from disease in that year of campaign is reported by the surgeon general to have been 15.30 per thousand; actually far less than that of the Japanese. This will be news to those who calculate the success of a sanitary corps on the basis of the battle losses.

"Another grave defect of this battle-to-disease ratio is that it gives no information of the progress of the sanitary corps, whether toward better things or worse. Col. Simpson, of the Royal Army Medical Corps, says: 'In McKenzie's tables and in others stress is laid on the ratio of loss by disease to that from battle. This is, of course, a legitimate comparison from some aspects, but it must not be diverted from its useful purpose, and employed as a criterion of the excellence of the medical service engaged.' He proceeds to show that the disease death rate may be increasing as compared with the battle losses, while the actual disease death rate computed for each thousand men is steadily declining; a state of affairs which actually occurred during the South African war. From 1899 to 1902 the disease death rate rose from twice the battle losses to four times their figure. By the usual fallacious reasoning the sanitary service was steadily declining in efficiency. In fact, it was steadily improving and the death rate from disease decreased from 38 per 1,000 in 1899 to 21 per 1,000 in 1902, or almost fifty per cent.

"How do these errors arise and what is the remedy? It is one of the simplest facts of mathematics that, in order to measure two unequal quantities, a single fixed standard is necessary. No rule-of-thumb carpenter would undertake to measure two boards using a foot rule for one and a metric tape for the other, and not knowing how to reduce the meter to feet. Yet that is precisely what is done by many writers. They say the Germans in 1870 had three-fourths as many deaths from disease as from wounds, while we, in 1861-65, had four times as many deaths from disease as from wounds. Ask them the relation between the battle losses and they do not know; do not even think it important. They are measuring by two standards.

"The idea of comparing disease with battles arose some years ago, when the world, and more especially the taxpayer, was not convinced of the necessity for organized medical departments for armies. In order to convince the reluctant taxpayers and their representatives of the necessity for a sanitary corps with proper rank and pay the argument that disease caused more deaths than wounds was presented. It proved an effective one. Surgeons to treat wounds had always been found necessary. Cabinets and chambers grasped the argument and provided for men to cure disease and later to prevent it. The comparison was

good and legitimately used, but since then it has been, as Col. Simpson says, 'diverted' and perverted to the purpose of comparing the efficiency of the sanitary services of armies, and it must be said that the tables in many works on military hygiene lend themselves readily to such a perversion. It is against this perversion, with its resulting haziness, confusion and positive errors, that I protest. The number of deaths from disease in each thousand men for each year of the war should be actually computed. The length of the war and the average number of men in the field are very important factors. Then the number of deaths and the efficiency of sanitary measures in the army may be fairly compared with those of another, in the same or another war. To be sure, there will be some small place for error, nothing human is perfect, but the ratio will be a very close approximation. If the data are worked out by months, it may be determined, as a war progresses, whether the sanitary corps is improving the situation or not. The number of deaths per thousand per annum is the only standard for measuring the efficiency of the sanitary corps of an army, using deaths as a basis. Deaths from bullets have nothing to do with the problem. To introduce them only leads to confusion and error.

"Deaths from disease, per thousand, per annum: British army in India, 1832 to 1852, 69; French army, Crimean war, 121; British army, Crimean war, 93; United States army, war with Mexico, 110; Union army, civil war, 53; German army, Franco-Prussian war, 18.8; United States army, Spanish war, 25; British army, South African war, 24; Japanese army, Russo-Japanese war, 25-30; Russian army, Russo-Japanese war, 25; United States army, Philippines, 1899, 15.3. The death rate for the Russo-Japanese war has not as yet been accurately determined. The number of deaths from disease in the Japanese army was 27,500, the time one and two-thirds years; the average number of troops could hardly have exceeded 550,000. This gives the death rate of thirty per thousand per annum."

The Speaking Dog "Don"

FOR several months a dog named "Don," which, according to newspaper report, actually speaks or articulates words, has been exhibited in Germany. Dr. Prochnow, in a recent issue of *Die Umschau*, gives an analysis of the dog's performance and dispels most of the glamor that has surrounded it. He finds that the dog, in reply to questions, barks a response which *can* be interpreted as "hunger," "ruhe" or "kuchen," indicating that he is hungry, sleepy or wants a biscuit. Don seldom answers promptly and correctly, and evidently does not understand the meaning of the questions. He does not even utter his own name correctly, as he cannot press his long tongue firmly enough against his teeth to produce the true sound of "D." The vowel sound is likewise imperfect, so that the name, as the dog pronounces it, sounds as much like "Wow" as like "Don." To the question "Was hast du?" Don responded with barks, some of which suggested the word "hunger." The word "haben" was "spoken" almost as a monosyllable and with very indistinct vowels, so that it differed little from "Don." The words "kuchen" and "ruhe" were also very much alike, as the "ch," "h," and "n" were very indistinct and the initial consonants were almost imperceptible. The indistinctness of the "r" is surprising, as many dogs produce this sound involuntarily.

In Dr. Prochnow's opinion, Don differs from other dogs only by a more highly developed imitative faculty and by the ability to produce several peculiar combinations of sounds which suggest spoken words. He shows no evidence of extraordinary mental ability, and often answers incorrectly. He apparently does not know the meaning of the questions which are addressed to him. These questions are usually propounded in a regular order, and the dog responds with the corresponding series of answers. That the dog once voluntarily uttered the sentence, "Don hunger haben" ("Don is hungry"), as has been asserted, is extremely improbable. The psychical problem of the speaking dog is similar to that of "wise Hans," the educated horse which attracted so much attention a few years ago. Don has also been trained by his numerous public performances, if not otherwise, and his exploits are elicited by favorite morsels. Hans learned to observe closely. Don has learned to repeat his stock of "words."

The principal factor in these performances is supplied by the hearer. Almost everybody who hears the speaking dog already knows the questions and answers, which are printed in a circular which is distributed among the audience. Hence the auditor often hears in the dog's bark the word that is already in his mind and almost in his ears. Most of the words employed are dissyllabic, like the usual bark of a dog. Despite this aid furnished by the self-deception of the audience, the young lady who exhibits the dog usually finds it necessary to interpret his replies.

The Design of Lightning Conductors and the Fundamental Principles Involved Therein

OUR ideas as to the mode of action and consequently as to the proper design of lightning conductors have changed materially within the last few decades. This subject is discussed by Prof. Slaby in the article referred to on page 622. The virtues of the old-fashioned rod with gold or platinum points are more or less illusive. Such a conductor, if improperly installed, may be a positive source of danger. For a projecting point on a building certainly does tend to draw the lightning upon it, while the path followed by the discharge subsequently depends on several factors, and does not by any means necessarily follow the line of the conductor. The fact which has to be borne in mind is that a lightning discharge is not analogous to a simple direct current, but is oscillatory in character. Hence in discussing the path followed by such a discharge we must take into account not simply ohmic resistance, but also impedance; that is to say, the part played by self-induction. This latter point is very clearly brought out by a simple little experiment, illustrated in the accompanying drawing (Fig. 1). A double loop is made part of an electric circuit. The one limb of the loop is formed into a U and made of wire of comparatively low resistance. The other limb is straight, and includes an electric lamp, whose filament, of course, represents a rather high resistance. If now the terminals of this loop are connected to a source of direct current of suitable strength, by far the greater portion of the current goes through the wire loop, and the lamp remains dark, the current through it being too insignificant to raise the filament to incandescence. If on the other hand a very high frequency alternating current is applied to the terminals, we now find that the lamp lights up brightly. The reason for this is to be found in the shape of the conductors, and is commonly expressed by saying that a loop of wire has a higher self-induction or a greater impedance than a straight wire. The effect of a self-induction is felt only while the strength of current is changing. For this reason it is of practically no consequence when working with direct current; but its importance is felt as soon as we have to deal with alternating currents, in which, of course, the strength of current changes from moment to moment. Thus if a lightning conductor is bent into a loop at any portion of its course, it may occur that the discharge has less difficulty in simply leaping across the loop through any intervening material than in following the "better conductor" along the loop.

Fig. 1.—Apparatus for demonstrating the significance of ohmic resistance and of inductance in determining the path of direct and high-frequency alternating currents.

Another point to be remembered in the design of lightning conductors is that for currents of very high frequency, such as a lightning discharge, it is practically only the surface of the conductor which is effective. For this reason a hollow pipe proves quite as useful as would a thick rod of the same external shape, and a good practice is to establish electric connections between all the gutters and other metal work of a building, as these, with their large surface, form an excellent conductor for high frequency discharges. Another feature which has been found to require more careful attention than was formerly bestowed upon it is the earthing connection. It used to be thought that merely burying the earthing plate sufficiently deeply to insure contact with the underground water was a sufficient precaution. What is needed is to insure that at the point of earthing a very large electric capacity is provided sufficient to fully insure that this point is made a loop for the oscillating discharge. It is not enough to merely provide a terminal plate of several square yards area. The best arrangement is a star of long radial wires, such as are now used for the earthing of wireless telegraphy systems. It is of interest in this connection to note the magnitude of the earthing arrangement at the great wireless station at Nauen. The total length of wire buried here is no less than 33½ miles, arranged in 324 radial spokes buried 82 feet deep in the ground. Probably the best grounding for a lightning conductor is the system of gas and water mains, and the best form for the lightning conductor itself is that of a metal cage, constituted by the metal parts on the surface of the building, which have been properly joined together.

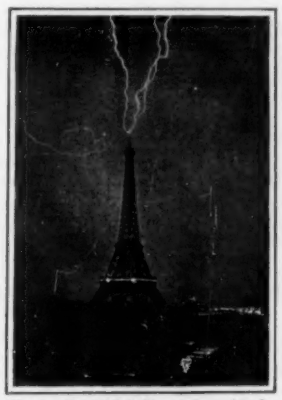


Fig. 2.—The Eiffel Tower in a thunder storm. The extensive ironwork of the structure presents an excellent path for the lightning discharge.

Why is Europe in Advance of America in Pioneer Inventions?

"EVERYBODY is familiar with the claim that American inventors, engineers and manufacturers lead the world," says *Engineering News*. "A vast amount of boasting has been done about American ingenuity and originality and enterprise. If this claim were well founded, it would be indeed matter for national pride; and a quarter century or more ago such a claim had a good deal to justify it. There are a number of fields of invention and manufacture in which the pioneer work was done by Americans and in which the statistics of exports still testify to our high standing.

"But," continues the *Engineering News*, "when one views the whole field of engineering and industry, and particularly the progress of the past twenty-five years, it is rather humiliating to confess that instead of being in the lead, the United States are lagging far in the rear.

"Take for example the advances made in iron and steel metallurgy during the past twenty-five years. Some original contributions have been made to the art by American inventors in that time, of course; but the great advances which have been made have almost all originated abroad. We are to-day something like five years behind Germany in iron and steel metallurgy, and such innovations as are being introduced by our iron and steel manufacturers are most of them merely following the lead set by foreigners years ago.

"We do not believe this is because American engineers are any less ingenious or original than those of Europe, though they may indeed be deficient in training and scientific education compared with those of Germany. We believe the main cause is the wholesale consolidation which has taken place in American industry. A huge organization is too clumsy to take up the development of an original idea. With the market closely controlled and profits assured by following standard methods those who control our trusts do not want the bother of developing anything new."

The *Engineering News* states that it instances metallurgy only by way of illustration. There are plenty of other fields of industry where exactly the same condition exists. Americans are building the same machines and using the same methods as a dozen years ago, and the real advances in the art are being made by European inventors and manufacturers.

"Those 'effete nations of Europe' actually appear to take a certain pride in doing *new* things that are worth while. Original work by engineers and designers is encouraged and rewarded. In some cases American manufacturers take up these foreign inventions after they have been developed on the other side of the water, and after four or five years the new improvement begins to be introduced here. In other cases a dozen years or more elapse before any American has enterprise enough to introduce here what has been proved to be excellent on the other side of the ocean.

"It would be easy to cite fifty or a hundred important inventions of the past quarter century which have originated in Europe.

"A notable illustration of this lack of originality in present-day American industry is the development of the internal combustion engine. There is no doubt that the application of this type of prime mover to a wide range of uses has been the most important development in mechanical engineering of the past twenty-five years; but the original work in this field has almost all been done abroad. We have merely copied the European inventions. Of course, there are some few meritorious details of design which have been worked out by Americans, but nearly all the really notable advances in the field of gas and oil engines from the beginning have been made in Europe."

Learning How to Fly

Hints from a Professional Aviator

By Antony H. Jannus

COMMON sense, mechanical ability, patience, good nerves and good eyesight are indispensable personal attributes of the man who wants to fly. To be sure, the same personal qualities are demanded of the automobile driver and the yachtsman, but on the ground that their necessity is not nearly so great as in the air. All things considered, the yachtsman will prove the aptest pupil in the air; for the handling of a boat is not unlike that of the handling of an aeroplane. Analogies, however, are dangerous, when it comes to the art of flying. Above all, the faculty of concentration, so essential in most sports, is absolutely essential in aviation.

Before we can learn to fly, we must have a safe and well-constructed machine. How the qualities of a machine may be determined varies with the circumstances. The best method is to employ a skilled aviator to drive the machine around a circular course. Where that is impossible, other considerations must guide the novice. Since the machine must stand the shock of alighting, and must ride through mud and weeds with impunity, it must first be ascertained whether or not it can stand abuse on the ground. A strong running gear is essential; for the shock of alighting on rough ground must not so weaken the machine that a fracture may later develop in the air.

After the novice has assured himself that the machine is strong and that it will hold together, let him compare its controls with those of machines of accepted type. Although radical departures may be good, they should be viewed with suspicion, and be accepted only after mature deliberation. The men who have been flying ever since the aeroplane became a practical machine have found that the present types of control are the most efficient; and their judgment should not be lightly disregarded.

Determining the Position of the Center of Gravity.

Before even ground work is attempted, the position of the center of gravity should be determined, in the manner shown in Figs. 1, 2, 3, and 4. At what point must the machine be suspended, so that it can tip only frontward and backward and be evenly balanced? That question must be answered in order to ascertain the possibility of the machine's pitching forward whenever mud, grass or rough ground is encountered in alighting. If the center of gravity should lie in front of the axles of the wheels, in a machine of the Farman type, trouble is sure to follow. Always consider the relation of the center of gravity to the wheels, in order that you may gain some idea of the distribution of the weight on the running gear when the machine is tipped forward ten degrees. If the wheels are not forward far enough, there will be trouble in running along the ground. The elevators must correct whatever variance there may be from correct center of gravity and position of the wheels, and the manipulation of the elevators for that purpose requires skill. If the tail is very heavy, the elevator may not be able to counteract the defect.

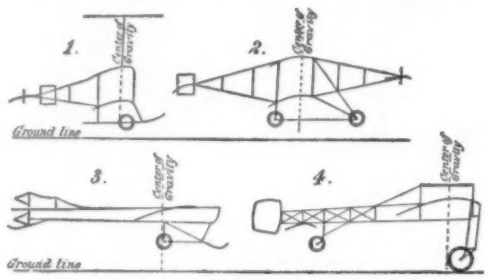
The position of the center of gravity of a machine in regard to lateral stability in flight is a matter of far greater importance than untried aviators realize. A center of gravity that is too low is as bad as a center of gravity that is too high. In either case there is a tendency to upset. Although the dihedral angle is considered wasteful of power, it seems to do more to secure inherent stability than any other device. Devices for maintaining stability automatically are to be frowned upon in the present state of the art. The sensitive perception and quick response which come with intimate knowledge of a machine's peculiarities are at present worth more than gyroscopes and pendulums.

In order to acquire this intimate knowledge, the aviator must familiarize himself thoroughly with his machine. He must become so accustomed to the controls that he and the machine are literally one. A practised bicycle rider does not have to think about his balance. Neither does the practised aviator. Yet the aviator must ever be prepared to meet motor stoppages, unusual air disturbances and breakages. A leap from the ground directly into the air without preliminary practice means certain accident, to put it mildly.

The mere statement of the necessary pre-requisite of becoming familiar with the machine implies ground practice. First of all, the aviator should familiarize himself with his seat; for it is in that place that he must judge wind effects, vibration, motor trouble and the thousand and one little creaks and hums that will ultimately mean so very much to him. Not until he has accustomed himself to his seat should the aviator try to run along the ground. When that time comes, he will find that it will first of all be necessary to learn the use of the rudder, particularly on rough ground. Hours should be spent in running up and down and around the practice field, simply for the purpose of studying the action of the rudder. The runs should be straight, so that when the time comes to leap into the air, the aviator may be sure that he is on an even keel, and flying straightaway.

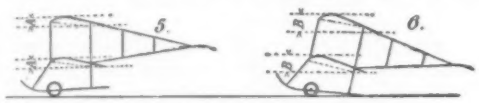
Ground Practice.

In order to avoid the possibility of leaving the ground in practice, the aviator should experiment



The position of the center of gravity.

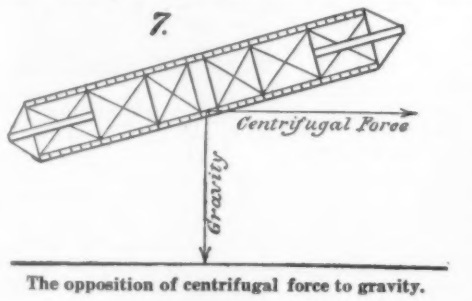
only in calm weather, and throttle down his motor so far that the speed of the machine will be reduced to ten or fifteen miles an hour. After a time, the speed can be increased to twenty miles an hour. That, however, is the maximum for ground practice. The machine will leave the ground at a speed not very much greater. In these practice runs on the ground, the aviator should learn to gage the rush of air against his face. In the air, his best gage will be the wind pressure on his cheeks; for that will tell him whether he is moving on with sufficient speed to keep up or not. It will also tell him ultimately whether or not



Running along the ground.

he is moving along the ground fast enough to leap up.

In this stage of experimenting on the ground, the elevator is kept neutral as far as possible. With increasing skill the aviator may venture to use the elevator, but only sparingly; for it takes but very little to lift a machine from the ground with a speed of over twenty miles an hour. It will soon be discovered that the elevator can be used as a brake to prevent pitching forward. Tail elevators on Farman or Blériot running gear are very effective because of the blast of the propeller, even when the main planes are not moving forward at lifting speed. With the Curtiss type of running gear and a front elevator only it is often possible at 18 or 20 miles an hour to raise the front wheel from the ground for a



The opposition of centrifugal force to gravity.

second or two. These facts should indicate that at speeds of 25 or 28 miles an hour the elevator should be even more effective.

The First Flight.

The first actual flight should be confined to a short trip parallel to the ground and not more than one or two feet above it. At first the aviator should see how close he can fly to the ground without actually touching it, which he can do by gradually increasing his forward speed. That must be done in an absolute calm. An appreciable amount of breeze will bring in too many other factors for the aviator to master at so early a stage. This practice should be continued in calm air a foot or two from the ground, until short, straight flights parallel with the ground can be made with the motor wide open. If it is found that the machine barely flies straightaway with the full power of the motor, it is certain that a more powerful engine must be installed. In an under-engined machine, turning is a reckless absurdity. Moreover, the resistance encountered in the air (greater than on the ground) is such that forward speed may be too low for sustentation. Figs. 5 and 6 will show why it is possible to run along the ground faster than in the air under certain conditions, and why the ground can be left at slow speed. If it were possible to drive a machine with such an enormous projected area as that shown in Fig. 6, a man could fly slowly for an indefinite period. But that projected area is greater than the air displaced by the propelier, and it is impossible to fly except with a moderate angle of incidence.

As he increases in skill, the aviator may venture to a height of over 10 feet, a height which he must maintain as accurately as before. After making a run of 50 or 100 yards, the machine should be pointed down deliberately, but ever so slightly. The wind pressure on the face immediately becomes greater. Within a foot or two of the ground, the motor should be cut off or throttled. This should be tried ten or fifteen times, and the height increased to 30 or 40 feet, in order that the aviator should familiarize himself with the feeling of coasting. At the end of each glide, the machine will seem to become more responsive, as indeed it does; for gliding down greatly increases the efficiency of the elevator and the other controls, because of the increased speed. Gliding down steep angles is often the salvation of the aviator in a tight place, particularly when his motor fails him, or a side gust threatens to upset him, or an air pocket is encountered.

When sufficient confidence has been acquired at a height of 30 or 40 feet, the ailerons or warping devices may be tried judiciously. Here the intention should be to correct any tendency to side tipping, and not purposely to incline the machine without actually causing a wreck. The use of the lateral control may cause the machine to swerve a little; but that may be ignored. Before landing, a straight course should always be taken, so that the machine will come down on an even keel.

With increasing practice, the aviator may fly higher, but always with the understanding that there is a limit to the angle of incidence. An automobile is retarded when it travels up a short, steep hill. So is an aeroplane. No aeroplane has yet been made that can take a steep angle and climb straight up that angle continuously. In the air, altitudes are reached by a series of steps, even at small angles. Unless the course is straightened out at regular intervals, a machine will lose all its speed, and can no longer stay aloft.

Making a Turn.

The first turn should be made on a large field, and the diameter of the turn should be at least half a mile. The height should not be less than 50 feet. After that level has been maintained for a few seconds, the rudder should be moved ever so little. The machine will lean in almost immediately, because the outer end travels at a higher speed than the inner, and has therefore greater lift. Ailerons or warping devices should be used to counteract the difference, and the rudder should be swung over in the opposite direction, if it should be necessary. It is obvious that if the rudder will cause the machine to bank when it is swung over in one direction, it will right the machine again when swung in the opposite direction. It is even possible to turn the machine on an even keel by anticipating the banking, simply by correctly using the rudder, which was necessary in the old Voisin machine flown by Farman in 1908, because it had no mechanical lateral control. The aviator should learn the correct angle of banking—in other words, the angle at which the machine will neither skid nor slide down—and which is most economical because it requires less use of the lateral controls.

The necessity of "feeling the air" is greater in turning than in any other phase of flying. Not until

(Continued on page 632.)

TWO answers have been received in response to our call for methods of reboring an engine cylinder. One of these is published herewith. The other will appear at the earliest opportunity. In the meantime other handy men may be inspired to suggest improvements on the methods here described.—ED.

How to Rebore an Engine Cylinder on a Common Lathe

By J. A. Bergstrom

ASSUMING that we have an old horizontal steam engine whose cylinder needs boring out, we may proceed as follows: After the cylinder has been detached from the engine and cleaned, it is placed on the tool carriage of the lathe with the valve seat down, blocked up approximately in center, and clamped down loosely. Old pieces of packing rings will serve best as parallel strips for this purpose (see Fig. 1). Now take an old piece of shafting about two or three times as long as the cylinder, and fasten an old pulley in about the center. This pulley should be somewhat smaller than the bore of the cylinder. The piece of shafting is now centered on the lathe and fastened with an ordinary lathe dog to the face plate in the usual way. In the periphery of the pulley are drilled three holes to receive the cutting tools, which, preferably, are threaded and fastened to the pulley with nuts, thereby affording adjustment to the tools. These tools are set in advance of each other so as to take cuts of different size. The last, of course, will be the finishing tool, which will be very wide and sharp, so as to give a finish to the cylinder. See Fig. 3 for the arrangement of the tools.

After the spindle with its cutting head is placed on the centers of the lathe the final "lining up" of the cylinder is to be done either by using one of the tools in the head for a guide or with any other suitable device. A very simple one is shown in Fig. 7, which is easily made and adjusted. It consists of a small stick of wood with a pin inserted in one end. The other end is made pointed. In use the end of the stick is pressed against the counterbore of the cylinder and the other end is moved back and forth, so that the head of the pin just touches the shaft (see Fig. 4), always turning the spindle so that the same spot thereon is used. When the cylinder has thus been centered and lined up perfectly true it is to be bolted down tightly and then it is ready to be bored.

The tool carriage is now moved to the extreme right and is fed in the usual way to the left. The tools are adusted, the lathe started up, using the back gear, and the boring may then take place. Care should be taken not to bore out any more than necessary, so as not to weaken the cylinder. After the cylinder has been bored out the counterbores at each end may also be cut a little deeper if necessary. The cylinder is now ready to be put back on the engine bed, and if it was not "pinned on" before, it must be "lined up," owing to the play in the bolt holes. Two pieces of wood are nailed together, forming a cross say about ¾ inch smaller than the cylinder. In each end of the cross is inserted a round-headed wood screw. A small piece of zinc or tin is nailed in the center and a very small hole drilled therein. This arrangement is shown in Fig. 9. The cross is now placed in the forward end of the cylinder shown at *A* in Fig. 2 and adjusted with the wood screws until the hole in the zinc plate is in the exact center. This can be done best with an ordinary pair of hermaphrodite calipers.

After the exact center is located, and the cross made tight in place, a silk cord is passed through the small hole and knotted on the outside. The other end of the cord is passed through the cylinder and fastened to a stick of wood, beyond the shaft and crank, and in the exact center thereof, and it is kept very tight. The front end of the cylinder is now bolted down. With the gage shown in Fig. 7 locate the center of the rear end of the cylinder, as before described, using the silk cord for a center, and by moving the cylinder to one side or the other until the center is located. Then the cylinder should be bolted down tightly.

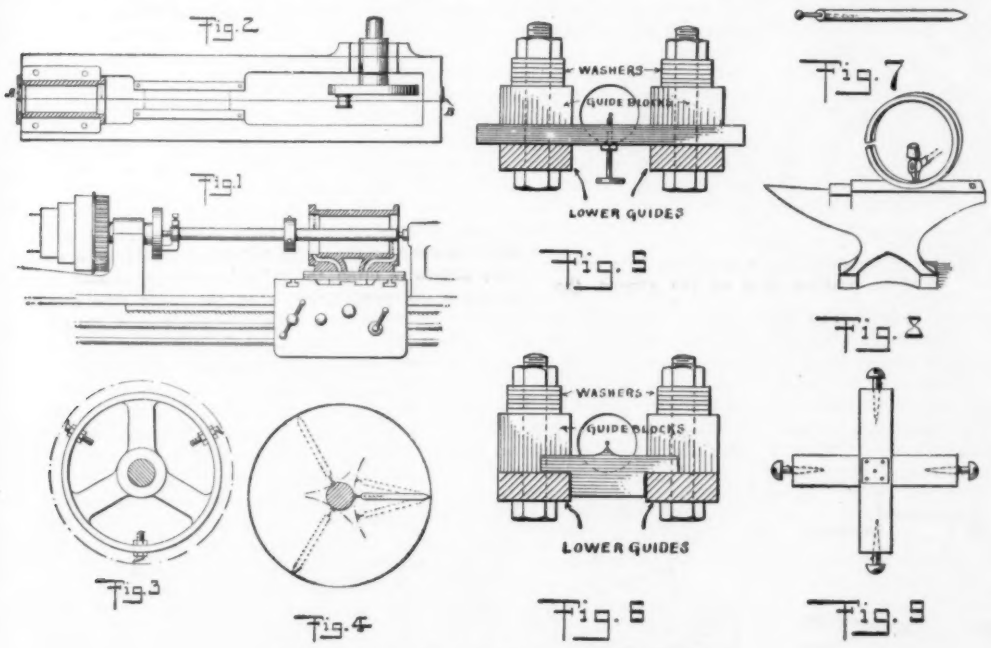
Naturally if the cylinder is worn the guides and crosshead are also. These should be filed up and tested with a straight edge before they are put back on the engine. If they are worn hollow lengthwise it is easier to spring them back than to file them straight, which will be explained later.

The guides should also be lined up after the same silk cord. To do this the bottom guides are first bolted on and lined up crosswise and leveled. The bolts should be drawn up "as for good" before using either level or straight edge, as the guides are likely to spring and twist either one way or the other. This may be rectified by putting a narrow strip of tin either in front, back or at the sides of the bolts, as the case may be, until they are both level and straight.

The distance between the center and the lower face of the crosshead is now measured with a small gage shown at Fig. 5, having a small adjusting screw in the center. The end of the adjusting screw is set according to the measure and the gage is placed on top of the lower guides at both ends. It will now be seen that the guides are too high and should be lowered until the end of the adjusting screw just touches the silk cord at either end of the guides. Washers of tin are cut out with the hole for the bolt running out to one side, so they may easily be put in or taken off. As the guides were all right before as to level and straightness care should be taken not to disturb these washers, and by only adding a few whole ones it will not change the guides in the least, only making them lower. Always tighten up the bolts every time as "for good" before any measurements are made.

After the lower guides have thus been lined up lengthwise they should also be lined up crosswise. This may be done with a small gage made of thin wood or metal shown in Fig. 6. The gage is made of the same width as the crosshead with overlapping ends and a pointer in the center. The gage is placed at each end of the guides, which are simply knocked over to one side or the other, until the pointer comes right under the silk cord. Ordinary bolts somewhat smaller than the holes in the guides should be used, so as to permit of moving the guides. The cord is now removed and the crosshead is placed on the lower guides without the piston head and rod. Then one of the top guides is put on and lined up until the crosshead is free to move back and forth, without any lost motion. The guide may be sprung and twisted as before described. The other top guide is now put on and finished up as was the first one. The holes in the guide and guide blocks should be reamed out and new bolts made in order to make a good job. The piston head and rod are now connected to the crosshead with the usual key.

If the cylinder has not been bored out too much the old piston rings may be used again. They can be made larger by placing them on an anvil or a block and hammering them all around the inside with a straight peen hammer, as in Fig. 8. This will spread them open and give them more life. If the cylinder has been bored out a great deal new rings will have to be made.



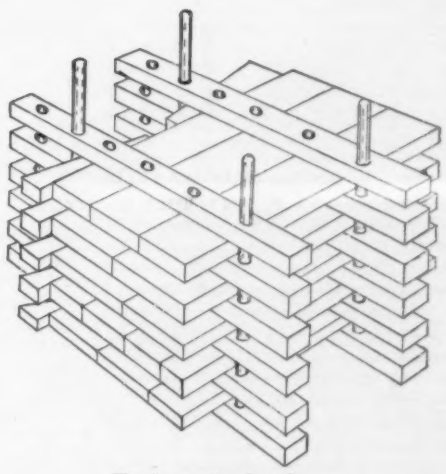
Reboring an engine cylinder on a common lathe.

A Good Glue Clamp

By Charles Cloukey

THE accompanying illustration shows a very efficient clamp for use at home, in the shop or in the factory. It is made by providing as many flat pieces with the holes in as desired, and providing as many round sticks or rods as necessary to do the work desired.

The flat pieces should be about ¾ inch thick, 3½ or 4 inches wide, and 3 or 4 feet long. The holes should be 1½ inches in diameter and the rods 1¾ inches. If gas pipe is used instead of turned rods, the holes should be about ⅛ inch larger than the pipe so that the cross pieces will slip over readily.



Handy man's glue clamp.

The holes should be bored about every 6 inches so that it will not be so much trouble to block out to the wedges in case the stock to be glued is not all of the same width.

This clamp will work equally well with one board or with a stack high enough to fill the whole length of the rods. The work is put in one layer at a time and wedged up tightly, and then the next one, and so on until the whole setting is in. The thickness of the different layers need not be the same, and the horizontal bars will hold the boards from cupping up or down no matter how tightly they are driven up.

Another advantage of this clamp is that extremely long stuff may be clamped up in the bottom of the stack and then shorter stuff added on top without taking up any extra floor space. And the most attractive feature of the device is its extreme simplicity, as it can be made by any man with the lumber and an auger. The sticks may be made square if it is inconvenient to make them round.

Fishing for Bolts

By G. H. Ander

THE other day I was told to put some bolts through the floor of an electrical locomotive. The holes were already drilled, but I found them to be in places where it was impossible for me to reach and put the bolts in from underneath, as they should be. The obstacles were some iron pipes containing cables for conducting the electrical current. I happened to have along some friction tape. Some of this I let down through the holes and between the pipes, fished it outside the locomotive, split the tape and fastened it to the threaded end of the bolt. Then I went up into the locomotive and slid the tape back through the holes, and in that way got the bolts up and the nuts secure in their places.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Principal Examiner George A. Nixon

GEORGE A. NIXON is a native of the Blue Grass State, claiming Covington, Ky., as his birthplace, residing in that section as a boy and attending Chickering Institute at Cincinnati, going later to Rensselaer Polytechnic Institute, and

Principal Examiner George A. Nixon.

finishing his engineering course at Lehigh University.

After completing his college course, he was for a number of years a member of the engineering corps of the Chicago, Milwaukee & St. Paul Railroad, both on construction and location work in Dakota and Iowa.

He was appointed a fourth assistant examiner in the Patent Office in July, 1884, and passing through the succeeding grades, was promoted to primary examiner in 1901. As assistant examiner he had a large experience in the class of mechanical engineering, and his engineering ability has manifested itself in his conduct of such classes as printing, paper manufacturers, elevators, card pictures, and sign exhibitors, buckles, buttons and clasps and metal working. In 1909 he was transferred to and assumed charge of Division 13, metal working. This class offers a large field, covering machine tools such as lathes, planers, drill presses, gear machines, screw cutting machines, forging machines, and others connected with the larger manipulations of iron and steel. The familiarity with heavy machinery gained by Examiner Nixon in the classes of mechanical engineering and printing stands him in good stead in his consideration of the large complicated machines forming a part of his present class, while his experience with the less complicated devices met with in some of the other classes he has examined aids him in the consideration of the simpler forms sometimes found in the classes which run generally to complicated machines.

It is always good to be able to say of a man that the more you know him the better you like him, and this is true of Mr. Nixon. He has a slight reserve, not a shell, and once known is found to be a delightful companion. He takes a broad view of patentability when real invention is present; but has strong views on the subject, much tenacity of purpose, and is characterized by a persistence in seeing to the bottom of a matter before reaching a conclusion.

He is a painstaking, thorough examiner, seeking in all instances to develop the facts having a bearing upon a case and applying the same with a calm judgment and a desire to do his full duty toward all concerned. His present division is and always has been rated as one of the important ones of the Patent Office, the advances in practically all other arts operating to magnify the importance of metal working machines, which are useful directly or indirectly in the development of all arts.

Cleaning with Electricity

SEVERAL authors of fiction have exercised their imagination in preparing a forecast of the civilized world as it will appear at some future date. Such writers have pictured the home of the future as equipped with a variety of labor-saving devices, which reduce housework to a mere incident. Much that has been thus prophesied in this as in other matters has come true in our own day. Perhaps one of the most efficient aids to domestic operations are the variety of carpet cleaners which have been placed upon the market. Especially vacuum cleaners present great advantages both in point of thoroughness and ease of operation. The illustration which accompanies this article shows a typical representative of this class. As is shown in the half-tone engraving and more in detail in the line drawings, the instrument consists of an electric motor driving a fan-blower, which latter creates the requisite blast of air to carry the dust from the floor or carpet through an outlet into a collecting bag. In the front portion of the sweeper, just over the suction opening, is located a rotary brush actuated by the same motor which also drives the fan. When the apparatus is in use for sweeping carpets the suction opening is raised somewhat from the level of the floor, and the force of the draft of air drives the carpet up against the suction opening, thus producing a vacant space between the carpet and the floor. This is shown clearly in Fig. 2, which represents a partial section through the front end of the apparatus. At the same time the brush is passed vigorously over the raised portion of the carpet, straightening the matted pile and dislodging the dirt. Owing to the pocket formed under the carpet, there is a rush of air right through the fabric, so that it is thoroughly purged of all dust. The use of such a sweeper brings with it a double gain. Not only is a perfect cleansing secured without effort in handling the instrument, but the tedious task of taking up the carpet and relaying it is either avoided entirely or at any rate occurs at much longer intervals.

The action of the blower can be reversed, and the machine then forms a very serviceable blower, which can be used for airing confined spaces, mattresses, bedding, etc., or for inflating pillows. The motor normally rotates at 3,400 revolutions per minute.

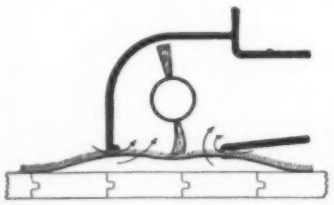


Fig. 2.—The carpet is drawn up against the suction opening, producing a space between the carpet and the floor.

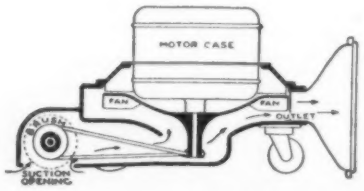


Fig. 3.—Section of electric sweeper, showing motor, fan, brush, suction opening, and outlet.

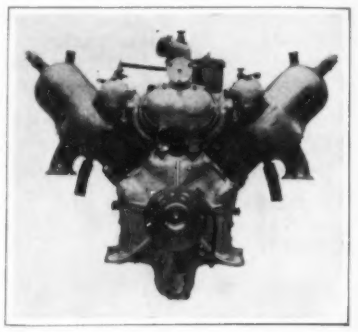
Fig. 1.—General view of the carpet sweeper in use.

A New Aviation Motor

Description of Novel British Aeroplane Engine of the Two-cycle Type

AS with the automobile, so with the aeroplane, the 2-cycle motor did not come into use at first; and even now it is only used in several rare instances. Nevertheless, it is the coming type of motor for one as well as for the other type of machine. In Germany Herr Grade, the inventor of the leading German monoplane, developed and has used from the start a 4-cylinder, V-type, air-cooled 2-cycle motor with success. The Gnome Company, in France, has experimented with a new type of 2-cycle motor, while in America most of the flights of our amateur aviators have been made with cheap 2-cycle water-cooled motors. The makers of such motors for marine use have quickly adapted them for aeroplane work, and on account of their simplicity and cheapness they have found a ready sale. In our May 28th issue of last year we described some new 2-cycle motors, including one for aeroplane work, and we are sure that our readers will be interested in this latest British engine.

The accompanying illustration shows a new aviation engine which has achieved some remarkable results in Great Britain, and which differs materially from most of the other engines now used for



N. E. C. two-cycle aviation engine.

flying purposes. It is constructed on the 2-cycle principle, and has apparently succeeded in actually attaining the ideal of 2-stroke engines—double power for a given size of cylinder to that obtainable from an engine working on the Otto or 4-cycle plan.

As is well known to automobile and gas engineers, the great difficulties hitherto found in 2-cycle engines have been those of properly clearing the exhaust gases and of preventing the fresh charge from becoming ignited by the remnants of combustion of the previous charge. The effect of leaving some of the burnt gases in the cylinder is obviously to fill the space which should be occupied by the fresh charge, and hence the full power of the engine is not developed. In aeroplane practice, especially, the importance of getting every ounce of power out of a given weight of engine is paramount, so that the method of expelling the exhaust gases by admitting a fresh charge is a cumbersome failure. Not only is valuable space wasted, but as some of the fresh gas is sure to escape with the exhaust, some of the fuel will be wasted, and this, again, increases the weight which the aeroplane would have to carry for a given distance of flight.

For this reason, in the N. E. C. engine, designed by Mr. G. F. Mort, an entire separation is made between the mechanism for utilizing the charge of gas, i. e., the motor proper, and the mechanism for introducing and expelling the charges. The use made of the piston, apart from its function in turning the force of explosion into mechanical movement, is that it serves as a compressor in compressing the charge of the fresh gas after this has been admitted to the cylinder and before it is exploded. It also acts as its own valve mechanism, as the ports which are cut in the walls of the cylinder for the admission and exhaust of the gas are covered and uncovered by the piston in its travel. All poppet or sleeve valves are eliminated. The inlet ports are placed at one side of the cylinder and the exhaust ports at the other, and the latter are continued farther away from the end of the cylinder, i. e., the exhaust port is larger than the inlet port in each case. The result is that the piston uncovers the exhaust port before the inlet port; the remnant pressure of the burnt gas as the end of the working stroke is approached, forces most of this out, and afterward the inlet port for fresh gas is uncovered.

It now remains to describe the separate system devised by Mr. Mort for admitting and exhausting the gases for the cylinder, which forms the unique feature of this most interesting engine. Stated in its simplest terms, it is a rotary blower combined with a rotary valve, both of these being gear-driven from the driving shaft of the engine. The blower is divided into two parts, one of which deals with atmospheric air and the other with the gas for explosion. The first thing that happens on an inlet port to a cylinder being exposed, is that a considerable quantity of air without the admixture of gas is blown into the cylinder. This has two effects. The first is to obviate the direct contact of a fresh charge of gas with the spent gases of a previous combustion which may still be flaming, and thus reduce the temperature of the cylinder contents and walls to a sufficiently low temperature to avoid back-firing. The second effect is that, by the interposition of a cushion of ordinary air between the escaping spent gas and the incoming fresh charge, the products of combustion are scavenged out of the cylinder before any of the fresh charge has an opportunity of escaping.

This rotary valve takes the form of a plain cylinder revolving on ball bearings, and thus absorbing a negligible amount of power, and its function is, as stated above, to delay the ingress of fresh gas into the cylinder until scavenging operations are completed. This simple device for introducing a puff of ordinary air into the cylinder has a most remarkable effect in increasing the output of a given size of engine operating on the 2-cycle principle, and disposing of the difficulties which have hitherto attended the practical use of this type of engine. The advantages of a 2-cycle engine in producing a more uniform turning moment are evident, especially where a chain drive has to be adopted, as the flutter of the propeller, which was sometimes evident in a 4-cycle engine, is done away with. The balance of the engine is improved and the power developed per pound of weight carried is far greater than in the 4-cycle engine. A figure of three pounds per brake horse-power is one which a year ago would have been regarded as Utopian, but neglecting the weight of lubricating oil, radiator, and cooling water, this figure is attained by the N. E. C. engine. Even allowing for these two items (and water-cooling is essential for this engine, as the cylinders are stationary) the radiator, water, and oil together do not weigh more than 70 pounds for a five hours' flight, inasmuch as the engine is most economical with regard to lubricating oil. Mr. Alec Ogilvie, one of the well-known British aviators, several months ago made a flight of 142 miles on a plane driven by one of these motors with complete success, and it is pleasing to note that an engine of British manufacture bids fair to challenge the performances of aviation engines of French manufacture, such as the Gnome, which, although air cooled, owing to its revolving cylinders, has undoubtedly a considerable consumption of lubricating oil, thus adding to the weight to be carried. For this reason the new engine is undoubtedly one which will be studied with interest by American engineers on account of the new principles of construction involved.

How I Invented the Air Brake—II*

By George Westinghouse

I SUPPOSE that many persons have heard or read the story of an alleged interview between Commodore Vanderbilt and myself about the application of air brakes to the New York Central. The story as told seems to have appealed to the imagination of many people. As a matter of fact, there is no foundation whatever for that story. From the moment when the practicability of air brakes was demonstrated to the present hour, there has been nothing but satisfaction and pleasure in being associated with an invention which has contributed so much to the safety and comfort of travelers and so greatly to the prosperity of railways.

In the development and introduction of the air brake, I was controlled by the apparent fact that the apparatus would have to be uniform upon all cars to provide for the convenient change of the composition of trains. It also was most obvious, in view of the crying demand for some better means for stopping trains, that some power brake would inevitably be universally applied to all of the cars and engines upon all railways. These ideas naturally involved a further one, namely, the importance of having all of the brake apparatus made by one company, so as to insure absolute uniformity and consequent interchangeability, and this led to the formation of the Westinghouse Air Brake Company early in 1869.

The essential parts of the air brake as first applied were:

An air-pump driven by a steam engine receiving its supply from the boiler of the locomotive.

A main reservoir on the locomotive into which air was compressed to about sixty or seventy pounds pressure per square inch.

A pipe leading from the reservoir to a valve mechanism convenient to the engineer.

Brake cylinders for the tender and each car.

A line of pipe leading from the brake valve under the tender and all of the cars, with a pipe connection to each brake cylinder.

Flexible hose connections between the cars provided with couplings having valves which were automatically opened when the two parts of the couplings were joined and automatically closed when the couplings were separated, so that the valve of the coupling at the end of the train was always closed and prevented the escape of air when introduced into the brake pipe.

The piston of each cylinder was attached to the ordinary hand-brake lever in such a manner that when the piston was thrust outward by the admission of compressed air, the brakes were applied. When the engineer had occasion to stop his train, he admitted the air from the reservoir on the locomotive into the brake cylinders through the train pipe. The pistons of all cylinders were, it was then supposed, simultaneously moved to set all of the brakes with a force depending upon the amount of air admitted through the valve under the control of the engineer.

To release the brakes, the handle of the brake valve was moved so as to cut off communication with the reservoir and then to open a passage from the brake-pipe to the atmosphere, permitting the air which had been admitted to the pipes and cylinders to escape.

The success of the apparatus upon the first train was followed by an application of an equipment to a train of six cars on the Pennsylvania Railroad, and in September, 1869, this train was placed at the disposal of the Association of Master Mechanics, representing numerous railways, which association was then in session at Pittsburg. The train was run to Altoona and the air brakes were used exclusively for controlling the speed of the train on the eastern slope of the Alleghenies, and special stops were made at the steepest portions of the line in such an incredibly short distance (as we all thought then) as to firmly establish in the minds of all present the fact that trains could be efficiently and successfully controlled by means of brakes operated by compressed air.

(To be concluded.)

* From Presidential Address presented at the Annual meeting of the American Society of Mechanical Engineers.

Legal Notes

The Right to Use an Abandoned Trademark.—In Seubert, Incorporated, vs. A. Santaella & Co., February 6th, 1911, the Court of Appeals of the District of Columbia, referring to two claimants of a trademark who were both using the mark at the time of its abandonment by the original owner thereof, says: "If two or more persons are using the mark at the time of abandonment, with or without knowledge of its prior use, neither would be prior to the other in point of time, since no one could in any event date priority of use beyond the time when the prior owner surrendered title by the act of abandonment."

Disclaiming Equivalents: A Novel Proceeding.—In deciding the case of the Diamond Rubber Company vs. Consolidated Rubber Tire Company, the Supreme Court said: "And a right to equivalence is disclaimed. Indeed, a certain merit is made of this, as exhibiting at once the simplicity and perfection of the invention." It appears to be a somewhat novel idea that a patentee can disclaim equivalents since it would seem that in doing so he would be disclaiming his invention. In other words, a patent without equivalents would on first thought be like "Hamlet with Hamlet left out."

An Adjudicated Patent.—The *Patent Office Gazette* of May 30th, 1911, reports ten adjudicated patents, two of which were held by the court to be void for lack of invention and one, a re-issue, void as granted without authority of law. The other seven patents were held to be valid, four of these were held to be infringed, and the other three not infringed.

An Old Device in a New Position Not Patentable.—In affirming the decree of the Circuit Court in Sieber & Russell Manufacturing Company vs. Chicago Binder and File Company, on January 10th, 1911, affecting a patent granted to Duffy, the United States Circuit Court of Appeals, Seventh Circuit, says: "Possibly there might have been invention in this change from one locking device to another, were the supplanting locking device itself new in the art. But it is not new in the art. It appears, precisely as the patent in suit adopts it, in the Lehy patent in the art of box fasteners. The patent in suit, therefore, has made no advance upon the previous art of loose-leaf binders, except to substitute, for the lock previously existing in those binders, a lock that previously existed in box fastenings. In our judgment, this transposition is not a patentable invention. As stated in the opinion of the court below, it is like putting the ordinary door lock into a new place, or using a lock buckle on a saddle girth or stirrup strap, and claiming for the result a patentable combination. In the new binder there is an old combination considerably improved, and a better result; but an old operation by old means."

A Knotty Question.—An interesting question as to patentability and infringement arose recently. For purposes of illustration, we will say A has a patent for an apple parer, including a holder and a removable blade. B, by accident possibly, finds that if he uses two blades one on top of the other, he gets superior results. It has been A's custom to sell the holder with several blades. If B secures a patent for his improvement can he have any redress against A for contributory infringement, even if A suggests to a purchaser the possibility of using his construction to secure the useful results incident to B's improvement? Did B make a patentable invention? He did not produce anything new, but simply a new use of the things already made by A, without any change whatever in the construction of the parts of A's device. At the same time, B's contribution to the art may be an important one.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT AND CAP BAND.—F. A. KOPP, Miami, Fla. Among the principal objects which this invention has in view are: To provide a device for tightening and loosening the grip of a hat or cap upon the head of the wearer; and to provide an auxiliary band for tightening the holding grip of a hat or cap upon the head of the wearer.

GARMENT.—V. M. SCHMITZ, New York, N. Y. In this invention the improvement relates to garments such as trousers and the like, and has reference more particularly to a garment which has an extensible waist portion formed with an opening, and having the edges of the opening arranged to telescope.

Of Interest to Farmers.

HAY FORK.—J. W. MELVILLE, Chippewa Falls, Wis. A fork is provided in this instance for conveniently and automatically handling hay, to reduce the amount of labor required in spreading the hay on the mow or the like. Use is made of a main stem, a trip rod mounted to slide in the main stem, and tines mounted to successively operate on the main stem when engaged by the trip rod.

GRAIN SEPARATOR.—E. P. BERGMAN, Cherokee, Okla. In this case the object is to provide a mechanism for use with separators using wind stackers, adapted to be arranged within the stacker for separating any grain that may remain from the straw, before the straw is delivered to the stack.

PICKER ARM.—F. J. BRIGGS, Glencoe, Okla. An object of this inventor is to provide an arm having a series of movable pins, which may be projected outwardly to engage the cotton, the pins being adapted to be withdrawn into the interior of the arm so that the cotton may be forced off from the arm.

Of General Interest.

RESTAURANT SERVICE.—P. KILLPATRICK, Huron, S. D. Means are provided in this improvement for serving a number of tables automatically, and by means of which the orders may be conveyed to the individual tables, and the empty dishes returned to the kitchen. The device is inexpensive, may be installed without any changes in the room and will do the work of many waiters.

STATEMENT AND BALANCE BOOK.—L. C. VAN VOORHIS, Salt Lake City, Utah. In this invention statements are arranged to serve as a bank balance or teller's record, from the first to the last of the month, after which the statements are taken from the book and delivered to the customers with their canceled vouchers. The numbers on the statement under the column headed "Date" designate the days of the month, and the colored sheets which divide the various series of names on the loose leaf are for assistance to the teller and other officers in referring to various accounts.

DRAINAGE LEVEL.—P. GUTWEIN, Jr., Francesville, Ind. The invention is a hydrostatic apparatus which includes two instruments having suitable graduations to indicate heights in inches, and provided with glass tubes which are connected by a flexible tube, the three tubes being, in practice, partly filled with a liquid whose level, in the respective instruments, indicates the difference of elevation between the stations or places where the instruments are located.

EXCAVATOR.—W. G. LAWRENCE, Crescent City, Ill. This improvement has reference more particularly to an excavator including a bucket for receiving material to be excavated, the bucket having associated therewith a member for emptying the bucket, means for holding the member against movement, and means for moving the bucket so that the contents thereof can be discharged when the member is held fixed.

ROPE BELT.—A. LUCKWEIL, Mannheim-Neckarau, Germany. The present invention relates to rope belts made from ropes of polygonal cross section, the adjacent ropes being sewn together in the longitudinal direction at a given angle to the plane of the belt. By this construction the whole fibrous material, that is to say both the ropes forming the belt and the sewing yarn, are subjected to longitudinal strains alone.

ARMORED PAVING.—P. P. MCMENAMIN, Jersey City, N. J. This invention relates to a new and improved paving for streets, roadways, trackways and the like. An object is to provide a concrete or cementitious roadway protected by armored blocks which are interconnected through openings therein by the cementitious material in which the blocks are embedded.

PUMP PLUNGER.—H. MEAD, Coalinga, Cal. The invention has in view a tubular plunger having a jacket covering of babbitt metal so applied that portions or lugs of the metal pass into openings through the wall of the plunger and securely unite the plunger body and jacket, yet fit with sufficient looseness to allow the oil pressure within the barrel to

expand the babbitt jacket and take up part of the wear.

DISINFECTING CABINET.—W. C. BURICHTER, Panora, Iowa. This cabinet may be manufactured at very little expense and is for use by physicians, nurses, manufacturers, druggists and also bankers for disinfecting money. Means provide for introducing and removing the disinfecting gas without inconveniencing those who are in charge of the device.

CENTRIFUGAL DRIER.—J. M. WHITE, Mapleton Depot, Pa. The object here is to provide a new and improved drier, more especially designed for drying wet sand and other wet material and arranged to permit continuous operation without danger of clogging and allow of running the drier with comparatively little power.

STUFFING BOX.—C. D. CAMPBELL, Lower Salem, Ohio. The patentee provides a stuffing box adapted for helical packing. The top tapers toward the inner end and the packing is similarly formed. Provision is made also for inserting the helical packing through a diagonally ranging opening in the gland or cap of the stuffing box, so that the packing may be entered through the opening and caused to embrace the piston rod or the like and fill the box.

BREAK GLASS FIRE ALARM.—C. AUTH, New York, N. Y. Mr. Auth's invention has for its more particular purpose the provision of fire alarms with an efficient testing device, and also to improve the general construction of such alarms. The conditions of the alarm can be tested by merely inserting a key; and when the test is over, all that is necessary to place the apparatus in normal condition is to press against the window, closing it with a snap.

TYPE WRITER CABINET.—KENNETH M. BYRON, 62 East Santa Clara Street, San Jose, Cal. This invention relates to typewriter cabinets, and the object is to provide a cabinet adapted to partially fold, to protect the interior of the cabinet from any dust and the like when it is not in use. For this purpose

TYPEWRITER CABINET.

use is made of a support provided with a removable table having receptacles and shelves, with parts of the table hinged to fold one part upon another, so that the interior will be protected from dust and the cabinet illustrated herewith will present a neat and compact article of furniture, adapted for the use of stenographers and typewriters.

HOLDER FOR GRAPHOPHONE RECORDS.—C. W. ALMON, Youngstown, Ohio. This invention is an improved holder or cabinet for disks or plates upon which graphophone records are made, and it is also adapted for holding music-sheets and various other articles. The inscription of the strips indicates the name of the subject of each graphophone disk, or its number, or both, as convenience may dictate.

MUSIC LEAF TURNER.—F. J. LATENNESSE, Hugo, Minn. The object of the inventor is the provision of a cheap and simple device for music leaf turning, which may be operated by repeated downward movements of the foot to turn a plurality of leaves in succession. Means provide for permitting the standard to be arranged at one side of the piano, where it will not interfere with the performer.

PILE PROTECTOR.—C. N. HUBBARD, Kamela, Ore. The invention is an improvement in protectors disclosed in Letters Patent formerly granted to Mr. Hubbard, wherein a casing surrounded by an air jacket is adapted to encircle the pile and move up and down thereon as the level of the water falls and rises, and has the upper portion thereof liquid-tight for containing a preservative solution of less specific gravity than the water.

DISPLAY STAND.—W. GILBERT, St. Louis, Mo. The invention provides a revolving stand to facilitate the handling and display of merchandise packed in cartons; provides a means for delivering the cartons so that the same may be handled for the delivery of the goods therein contained; and provides a stand, simple, durable and efficient.

WAVE MOTOR.—R. E. BRAKEY, Ventura, Cal. This invention contemplates the independent vertical adjustment of the wheels to compensate for the rise and fall of the water level due to the tide, and the adjustment of the wheels to and from each other to increase or decrease the sag in the lower chain, in order that the chain may be adjusted to the slope of the shore line which is varied by the drifting of the sands.

APPARATUS FOR PREVENTING EXPLOSIONS AND DANGER FROM THE ESCAPE OF GAS.—W. A. J. VAN DE KAMP, 20 Jansweg, Haarlem, Netherlands. This invention has reference to apparatus for preventing explosions and obviating the risk of poisoning by reducing the waste of gas due to unavoidable though unintentional escape from pipes in buildings and closed rooms, and for giving warning of the accumulation of dangerous gases in mines and the like.

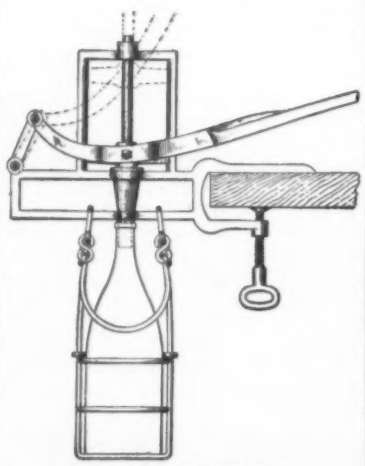
PROCESS OF BREAKING UP AND SEPARATING THE GASEOUS LIQUID AND SOLID CONSTITUENTS OF CRUDE PETROLEUM.—L. W. BROWN, Monrovia, Cal., deceased. G. F. BROWN and DAISY L. CONDON, executors. Crude petroleum, more especially that delivered from oil wells of California, is a thick, mucky, viscous, spongy, sludge-like substance containing fixed gases, sand, water, asphaltene, clays, and other minerals in complete and perfect emulsion with the oil, which emulsion is the result of long periods of confinement under extraordinary heat, pressure and chemical conditions. The inventor has successfully applied crude oil separators in the operation of his process to improve the conditions named.

Hardware and Tools.

HAME FASTENER.—C. G. GERLACH, Versailles, Ohio. Means provide in this invention for a ready and efficient locking of the hames in tightened position and for the operation of reversing so as to release the hames when desired. The device will be placed on the market as an independent fastening device, and will be sold with the hames. It is practically indestructible with ordinary care, and by its use, the hames may be secured in place in a minimum of time.

BOLT MECHANISM FOR DOORS.—S. N. FRIEDMAN, New York, N. Y. In this instance the invention relates to mechanisms for securing doors and the like, and has reference more particularly to a device of this kind provided with locking bars, and means for projecting and retracting the bars, the bars when projected being alined and engaging end to end.

BOTTLE CORKING MACHINE.—J. E. ROVETTI, 159 Berlin Street, Montpelier, Vt., care of Richard A. Hoar, Barre, Vt. This strong, simple machine can be manually operated with comparatively little effort; is provided with a bottle holder obviating the necessity of positioning the bottle by means of the hand, and thus doing away with the danger to the hand should the bottle break



BOTTLE CORKING MACHINE

while being corked, and can be easily attached to a table or any other suitable support. In operation the moistened cork is introduced into the guide and the plunger is moved downward into engagement with the cork and forces it through the guide. The cork is compressed in passing through the guide so that it can freely enter the bottle mouth. The plunger is raised and the bottle carrier lowered, so that the bottle can be removed and another placed in the carrier.

CONVERTIBLE COUCH AND BED.—I. MASON, New York, N. Y. In this patent the invention has reference to household furniture, and the object is to provide a couch and bed, arranged to permit quick and convenient converting of the piece of furniture from a couch to a double bed and *vice versa*, and to accommodate the bedclothes when using the piece of furniture as a couch.

COMBINATION SHOVEL, PLOW, AND SCRAPER.—E. T. HARVEY, Salt Lake City, Utah. The object here is to provide a simple tool especially designed for removing snow, which with slight changes may be used as a shovel in the ordinary manner, as a scraper to loosen and scrape up the snow, as a pusher to push the accumulation, and as a plow to throw the snow to each side.

SCOOP FOR MEASURING PLASTIC MATERIAL.—L. O. WELLS, Bonne Terre, Mo. The invention relates to scoops for plastic materials such as lard and butter, ice-cream, peanut butter and maple butter. The main intention of the present patent is to improve the means whereby the plastic materials are to be loosened from a receptacle containing them and afterward ejected from the barrel of the scoop.

PIPE WRENCH.—P. E. ERICKSON, Port Chester, N. Y. This invention pertains to pipe wrenches having a chain and lever, for instance, such as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Erickson. The object of the present invention is to provide a wrench, arranged to permit firm gripping of pipes of different sizes, and to quickly release the chain when releasing the grip of the pipe.

TRESTLE CLAMP.—F. P. DOUGLASS, Pasadena, Cal. The object here is to provide a clamp very cheap and simple in construction and operation, and one of great strength; in fact the heavier the load the more firmly does the clamp hold the trestle members together. It may be exposed to the weather without danger of its efficiency becoming impaired by rust.

WEIGHING SCALE.—C. M. STURGIS, Birmingham, Ala. This invention provides a balancing mechanism for a scales platform which is economical and durable; provides in a construction a rocking beam extensible at a cost proportionate to the dimension; and provides a scale lever which is constructed and arranged to support in part the weight of the rocking shaft.

Heating and Lighting.

GAS LIGHT ATTACHMENT.—C. W. GROENING, New York, N. Y. This invention pertains to an attachment whereby a cluster of lights on a chandelier may be successively and individually controlled. An object is to provide a device adapted to control the flow of gas to any one of a plurality of burners arranged in a cluster, with means for simultaneously controlling the ignition of the gas flowing from said burners.

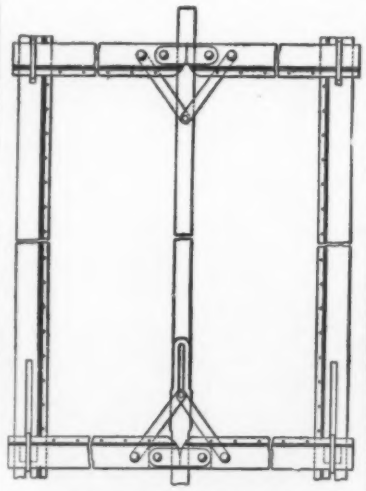
STEAM GENERATING PLANT.—A. E. DOBBS, Castle Dobbs, Carrickfergus, Ireland, W. East, Bournemouth and J. S. HOWKINS, 40 Waldemar Mansions, Fulham, London, S. W., England. This invention relates to boilers of the "flash" type, in the construction of which difficulties have arisen. The aim is to overcome these, and the invention consists in a steam generator comprising a flash element combined with a thermal storage element so that the contents of this element may be delivered to the flash element for meeting overloads.

ACETYLENE GAS GENERATOR.—H. N. LINES, Sabetha, Kan. The object here is to provide improvements in generators, whereby a continuous feeding of the carbid takes place in proportion to the consumption of the generated gas, and whereby an alarm is sounded whenever the carbid is nearly exhausted, thus giving the person in charge plenty of time to re-charge the apparatus with carbid.

Household Utilities.

SHELF ATTACHMENT FOR TUBS.—J. M. CAHANEY, Dennison, Ohio. The purpose of the inventor is to provide an attachment which is mounted upon the upper edge of a tub, and which serves as a soap support, maintains a wash-board inclined at the proper angle for service and effectually prevents wash-water in the tub from splashing over the edge of the tub behind the wash-board.

SELF SQUARING CURTAIN STRETCHER.—JOHN O. HOLMQUIST, care of the Holmquist-Swanson Co., 2438 North 40th Avenue, Chicago, Ill. The object of the invention illustrated in the accompanying engraving, is to provide a curtain stretcher, arranged to permit convenient folding when not in use, and to allow moving its side bars and end bars into a square position relative one to the other when opening the stretcher, to insure proper ac-



SELF-SQUARING CURTAIN STRETCHER.

LEGAL NOTICES

PATENTS

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Inquiry No. 9239.—Wanted, addresses of parties who can ship ores containing any of the following elements Vanadium, molybdenum, uranium, tungsten, titanium.

Inquiry No. 9240.—Wanted, address of owners of limestone beds running not less than 98 per cent, and near a railway.

Inquiry No. 9241.—Wanted, addresses of owners of deposits of molders' sand suitable for heavy castings.

Inquiry No. 9242.—Wanted, addresses of makers of bag valves.

Inquiry No. 9243.—Wanted, address of maker of Rover's monogram embossers.

Inquiry No. 9244.—Wanted, address of manufacturers making rollers, scrapers, and driers suitable for making soap leaves.

Inquiry No. 9246.—Wanted, addresses of parties having raw materials or minerals containing potash in any form.

Inquiry No. 9247.—Wanted, to buy a Parmelee aerated water.

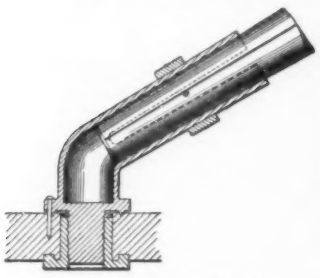
Inquiry No. 9254.—Wanted, the name and address of manufacturers of lead pencils and pen holders, such as are used for printing advertisements on.

Inquiry No. 9255.—Wanted, to buy a patent roller, a ball-bearing axle, which could be purchased on a royalty basis; it must be cheap and fully proved.

curate stretching of the curtain while drying the same. For the purpose mentioned the end bars of the stretcher frame are made in sections pivotally connected with each other, and engaged by a guide bar and links to insure proper opening and closing of the sections.

RANGE.—P. RIESS and D. LEMLEY, New Orleans, La. The object here is to provide an arrangement whereby the cook on opening the oven is protected from the heat. The device is constructed so that the pans in which articles of food are being roasted will advance automatically out of the oven when the door is thrown open. This is useful when necessary to baste the article.

BROOM HANDLE HOLDER.—ASIMAN BIBAUW, 253 W. 15th St., New York, N. Y. Among the principal objects which the invention shown herewith has in view are: To provide a holder which is adjustable to backs of brushes of different thicknesses, and to handles therefore of various dimensions; and to provide a simple, durable and efficient construction which may be quickly adjusted and when so adjusted set in fixed position with reference to the handle and the brush. The handle may be constructed from any suitable material. The outer end of the split holder is flared and the sides are resilient to provide for tapered ends of handles of various diameters.

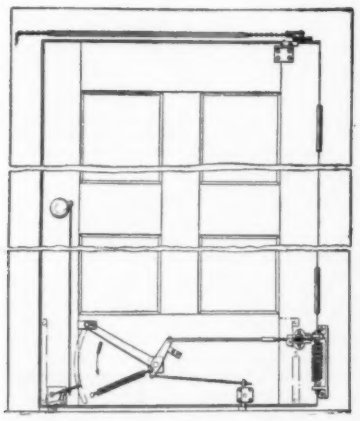


BROOM HANDLE HOLDER.

Machines and Mechanical Devices.

AIR COMPRESSOR.—H. E. BAILEY, Albany, N. Y. The object of the present invention is to provide a compressor arranged to insure a proper inflow and outflow of the water to prevent the water from accidentally passing into the outflow and into the receptacle filled with the beer or other liquid. The invention relates to hydraulic air compressors shown and described in Letters Patent of the U. S., formerly granted to Mr. Bailey.

DOOR OPERATING DEVICE.—CHRISTIAN ALTER, 500 E. 83rd St., New York, N. Y. The illustration shows a side elevation, provided with the operating device, the door being closed and locked, and the cover of the device shown in dotted lines. The device is for use on doors of stores and other buildings, and is arranged to permit a person carrying bundles, packages or the like, or otherwise encumbered, to unlock or open the door by pressure of the foot, and without use of the hand, to hold the door in open position for time to allow of passing conveniently through the open doorway, and to insure self closing and locking after passing through.



DOOR OPERATING DEVICE.

WING FOR FLYING MACHINES.—W. KRIEDTER and W. H. BOURDON, New York, N. Y. This invention provides a wing or analogous member for use in connection with the machine. The inventors have discovered that if, in almost any type of flying machine, where a wing is used, the outer end of the wing be provided with a box, made after the manner of a kite box, the stability of the wing and of all mechanism controllable by it is greatly increased. Also, that if a wing be built with a box at its outer end, a comparatively small wing surface will answer for a given breadth and length of wing, and a greater power is attained for steering, floating, steadying, or otherwise controlling the craft to which the wing relates.

SAFETY ATTACHMENT FOR ELEVATORS.—J. R. INKSTER, Omaha, Neb. The invention provides means for locking the controlling lever, which means are placed in locking position by the opening of the entrance doors to the elevator shaft to prevent accidental rise and fall of the car while receiving passengers; to simplify the mechanism for locking the lever; and to so construct and arrange the locking mechanism as to adapt it for employment in elevator shafts where the doors are operated to swing or to slide vertically or horizontally.

WELL DRILLING DEVICE.—R. R. SANDERSON, Orrville, Ohio. The aim here is to provide a device of the walking beam type, in which the rapidity of oscillations of the drill rod may be considerably increased without sacrificing its effectiveness in any particular, thereby rendering the machine capable of doing more work in a given time than the ordinary drilling device.

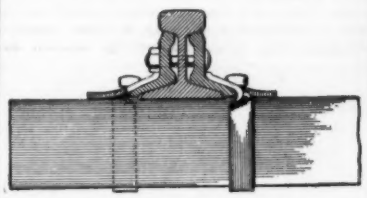
WINDING MACHINE.—R. C. CAMPBELL, Harlan, Iowa In this patent the improvement broadly considered, comprises a disk mounted for rotation, and provided with a central opening, the disk being divided transversely through the opening, and provided with means for detachably connecting the sections, together with the reels and the tensioning device.

Railways and Their Accessories.

WHEEL GUARD.—W. T. WATSON, Vancouver, Canada. This improvement refers to wheel guards for street cars, and relates more particularly to that type of guard in which there is a fender or cradle normally supported at a short distance above the track, but connected to a trip device, by means of which the fender may be lowered into operative position.

CAR FENDER.—H. S. BEATTIE, Teziutlan Puebla, Mex. This invention refers to a fender which is adapted to be operated either by the motorman or automatically by impact with an obstacle or person to lower the fender into intimate contact with the ground, whereby the person or obstacle is safely picked up and deposited on the fender out of harm's way.

RAILWAY RAIL AND NUT LOCK.—BARTON ESTES, 533½ 1st Ave., Seattle, Wash. Among the principal objects which the present invention has in view are: To provide devices to prevent the separation between railway ties and railway rails, and subsequently loosening and partial pulling of the holding spikes, particularly at the rail junctions; and to provide a simple, economical and efficient nut lock. The vertical cross section shown is of a railway rail and fish plate for securing the junction, together with the devices for preventing the separation of the rail and tie.



RAILWAY RAIL AND NUT LOCK

AUTOMATIC BRAKE SETTING MECHANISM.—G. H. LOWELL, Birmingham, Ala. The invention provides a mechanism operable from outside the cab structure to automatically set the brakes of an engine or train; provides a construction wherein the automatic operation may be avoided only by vigilance on the part of the engineer, and provides a construction whereby the operation of the brake mechanism may be set with reference to arbitrary selection.

Pertaining to Vehicles.

BRAKE BLOCK HOLDER.—H. EVANS, Ross, Wyo. This improvement pertains to holders for the brake blocks or shoes of farm wagons and other vehicles, and has reference more particularly to a device, comprising a fixed jaw, a movable jaw, and common means for securing the jaws upon a brake beam, and for holding them adjustably relative to one another, the jaws holding the brake block.

VEHICLE WHEEL TIRE.—M. B. CARMODY, Columbus, Ohio. The invention embodies novel details, that are simple, durable, afford interior ventilation and elastic support to the body of the tire, and which permit a quick and convenient detachment of the exterior of the body of the tire from the wheel rim, as well as the removal of details from the tire body if occasion requires.

Designs.

DESIGN FOR A CABINET.—L. N. LEVINSOHN, New York, N. Y. In this ornamental design the vertical body of the cabinet is square and of simple lines. The top and base are flat and only slightly project beyond the uprights. The face of the cabinet is crowned by a peaked elevation holding the dial of a clock.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

You Don't Know Discomfort
When You Wear B. V. D.

WHETHER you walk or work, stay in town or go away, lounge or even dance in "stuffy" rooms, keep *cool* and *comfortable* in Loose Fitting B. V. D. Coat Cut Undershirts, Knee Length Drawers and Union Suits. The heat of summer days and the sultriness of summer nights are *felt least* in these *loose fitting* garments made from *light woven* fabrics, soft to the skin. This right-idea underwear cools your *body*, and calms your *mind* and *mood*.

This Red Woven Label

MADE FOR THE B.V.D. BEST RETAIL TRADE

(Trade Mark Reg. U. S. Pat. Off. and Foreign Countries.)

is sewed on *every* B. V. D. Undergarment. Take *no* undergarment *without* it. Write for booklet, "*Cool as a Sea Breeze.*" *It's free.*

B. V. D. Union Suits (Pat. 4/10/07) $1.00, $1.50, $2.00, $3.00 and $5.00 a suit.

B. V. D. Coat Cut Undershirts and Knee Length Drawers, 50c, 75c, $1.00 and $1.50 a garment.

The B. V. D. Company,
65 Worth St., New York.
London Selling Agency, 66, Aldermanbury, E. C.

"The D & H"

The Natural Attractions of

Lake George, Lake Champlain and The Adirondacks plus their accessibility

from the great centers of population, form a combination most desirable to the tourist. Easily and quickly reached by the Leading Tourists' Line,

THE DELAWARE & HUDSON

Ask any Railroad or Steamboat Agent. Free folder on request.
Summer book (360 pages) 6c postage.

A. A. HEARD, General Passenger Agent, Albany, N. Y.

Again a Doubled Demand for No-Rim-Cut Tires

About two years ago the Goodyear No-Rim-Cut tire—our patented tire—began to become the sensation. It was the final result of ten years spent in tire-making.

Last year our tire sales trebled—jumped to $8,500,000—because of this tire's popularity.

This year 64 leading motor car makers made contracts with us for No-Rim-Cut tires.

Now, about 600,000 No-Rim-Cut tires have been sold—enough to equip 150,000 cars. The result of their use is this:

The demand for these cars is more than twice that of last year—six times that of two years ago.

Our enormous plants, with three shifts of men, are run night and day. Our daily output is 2,200 automobile tires. Yet we can't keep up with our orders.

The reasons are these:

Goodyear No-Rim-Cut tires make rim cutting impossible. They are, in addition, 10% oversize. That means 10% more carrying capacity. With the average car it adds 25% to the tire mileage.

These two features together, under average conditions, cut tire bills in two. Yet they cost nothing extra. Is it any wonder that buyers, when they learn these facts, demand the No-Rim-Cut tires?

Our TIRE BOOK—based on twelve years of tire-making—tells many facts you should know. Ask us to mail it to you.

GOODYEAR
No-Rim-Cut Tires
With or Without Non-Skid Tread

THE GOODYEAR TIRE & RUBBER COMPANY, First Street, AKRON, OHIO
Branches and Agencies in 103 Principal Cities (316) *We Make All Sorts of Rubber Tires*
Canadian Factory: Bowmanville, Ontario Main Canadian Office: Toronto, Ontario

NEW BOOKS, ETC.

ELEKTRIZITAET AUS KEHRICHT. Von Etienne de Fodor. 170 original illustrations. 224 pp. Budapest: K. U. K. Hofbuchhandlung von Julius Benko, 1911.

THE GRAPHIC ARTS FOR PRINTERS AND USERS OF PRINTING. Boston: National Arts Publishing Company, 1910. Price, $2.50 per year.

The art of printing has been much advanced by *The Printing Art*, which we have noticed on many occasions, and now we have a worthy competitor in *The Graphic Arts*. It is a superb production filled with beautiful plates and examples of printing art. Only three numbers have appeared so far, but the quality of the magazine is well shown in these numbers. Mr. Henry Lewis Johnson is to be congratulated on this new enterprise. It is a periodical as necessary to the modern printer as is his imposing stone.

AERONAUTISCHE METEOROLOGIE. Von Dr. Franz Linke. I. Teil. Frankfurt a. M.: Verlag von Franz Benjamin Auffarth, 1911.

Dr. Linke's treatise on the above subject, the first volume of which has just appeared, if not an epoch-making, is certainly an epoch-marking work.

Anyone who opens this little brown volume expecting to find merely a cut-and-dried exposition of the long familiar facts of meteorology, with just enough speculative discussion of the aeronautical bearings of the subject to give an excuse for the title, will be delightfully disappointed. The fact is that a new branch of science has been built up (and chiefly in Germany) during the past ten years, and to Dr. Linke belongs the honor of having written the first comprehensive account of it. The greater part of the information contained in this book is, in fact, less than five years old, and some of it is "as young as yesterday."

In writing this work the author has had a double object in view; first, to provide a practical handbook of aeronautical meteorology, the first of a class of books the utility of which to the aeronaut is destined to be even greater than that of works on maritime meteorology to the mariner; and second, to bring the aeronaut into sympathetic relations with meteorologists who are studying the free air, so that he may be able to co-operate intelligently in their important researches. In carrying out the latter purpose, the author throughout the book calls attention to phenomena concerning which the existing data of observation are insufficient, and points out how the aeronaut may aid science (and indirectly benefit himself) by adding thereto.

The reader will, however, be struck by the fact that an immense amount of information regarding the phenomena of the atmosphere far above the ground has already been acquired by the direct observations of aeronauts and aerologists. Here, again, we must reiterate the statement that a major part of our knowledge of these phenomena has been "made in Germany," where the art of navigating the air is being cultivated, in both its practical and its scientific branches, to a degree that is hardly appreciated on this side of the Atlantic.

The following are a few of the features of Dr. Linke's book that may be cited to show how its scope differs from that of ordinary works on meteorology:

The author begins by discussing thermal radiation, and proceeds from its general meteorological relations to the important rôle that it plays in ballooning. Under sunshine, the gas in a balloon becomes much hotter than the surrounding air—the difference sometimes amounting to 30 deg. Centigrade—and its buoyancy is correspondingly increased. The cessation of sunshine, owing to the intervention of clouds or the setting of the sun, leads to a cooling of the gas, by radiation, to a temperature of 5 to 10 degrees below that of the surrounding air; hence the balloon tends to fall and ballast must be thrown out. In this connection are given descriptions and illustrations of a special form of the Angström pyrheliometer, adapted for aeronautical use; a platinum resistance-telethermometer for measuring the temperature of the gas during a balloon voyage; and a thermograph for making a continuous record of the temperature within the bag.

Next we come to a section on the composition and contents of the atmosphere, and here, for the first time outside of periodical literature, we meet with the categorical statement that the atmosphere comprises three distinct strata, viz.: the cloud zone, extending up to about 10 kilometers; the stratosphere, beginning at 10 kilometers and extending to 60 kilometers; and the stratum of lighter gases lying above 60 kilometers. This section also deals with the turbidity of the atmosphere, mechanical and optical, and describes the peculiarities of its vertical distribution, especially as related to the distribution of barometric pressure at the earth's surface (i. e., the occurrence of cyclones and anticyclones).

Barometric pressure—a subject of extreme interest to the aeronaut on account of its connection with hypsometry, buoyancy, and air-resistance—is discussed at length. Special attention is given to the matter of testing and calibrating aneroid barometers and barographs. Of apparatus for determining pressure-change (whence the vertical motion of aircraft is inferred) the author selects for description and illustration the statoscope and Bestelmeyer's balloon-variometer (both of which were discussed in the SCIENTIFIC AMERICAN of February 25th, 1911, p. 196).

A long chapter is devoted to the movements of the air; the most important class of meteorological phenomena from the aeronaut's point of view. Here we have a practical discussion of anemometry, which displays the familiar *penchant* of the European meteorologist for the Beaufort scale, as compared with instrumental methods. The technique of pilot-balloon observations for determining the direction and force of the upper air-currents—now a usual preliminary to the voyages of manned balloons in Europe—is fully explained. The variations of the direction and force of the wind with altitude are discussed in connection with their many important aeronautical bearings. Balloonists are reminded that at the altitudes ordinarily reached by a free balloon the wind generally coincides in direction with the isobars. Hence the path of the balloon may be readily inferred from the weather map. The force of the wind does not on an average increase upward so rapidly as was formerly supposed. On the other hand, abrupt changes of wind force with change in altitude frequently occur, and are often fraught with danger, especially to aeroplanes. The stability of the latter is severely tested when crossing the boundary plane between strata of markedly different velocity; the heavy motor and propeller, owing to their inertia, tend to retain the velocity they previously had, while the planes tend to adjust themselves to the wind. Vertical movement of the air is discussed as fully as the rather meager information available on this subject admits. Meteorological observatories almost universally confine their measurements to the horizontal component of the wind. While the vertical component is, when of average magnitude, of no practical interest, it may depart very widely from this average; under certain conditions amounting to more than 8 meters (26 feet) per second. Such vertical velocities occur, for instance, in thunder squalls, and may prove disastrous to the aeronaut—as happened when the airship "Deutschland" was wrecked over the Teutoberg forest.

Wind structure, and the effects of the well-known gustiness of all lower winds upon aircraft, are discussed at some length; but we miss any reference to the brilliant researches of the British meteorologists and physicists who have done more than any others, since Langley's time, to elucidate this important branch of atmospheric physics.

In a long chapter on air temperature the author returns to the subject of the relations of this element to the buoyancy of balloons. The last chapter of the book discusses atmospheric moisture and precipitation, and concludes with the possible effects of heavy deposits of snow and ice upon the stability of dirigibles.

The second volume of Linke's pioneer work will be awaited with impatience by all meteorologists and scientific aeronauts.—C. F. TALMAN.

ROADTOWN. By Edgar Chambless. New York: Roadtown Press, 1910. 172 pp.

In this book Mr. Chambless has given us his idea of the noiseless, smokeless, dustless, streetless, horseless, trustless, graftless city, a city which he calls Roadtown, and which may be best described as a single line of houses of any length, built upon three superimposed lines of railway. There are two stories of living and working rooms above ground, a continuous promenade along the connecting roofs of the houses, and gardens or farms on either side. Roadtown, in Mr. Chambless's words, "is the modern sky-scraper laid on its side and built out to any length." Instead of elevators, he uses trains, of course, but not ordinary trains. He would use a special monorail system of transportation, devised by Boyes, and for which extreme rapidity, efficiency, lightness, and above all, silence, are claimed. This railroad will have three tracks, one beneath the other, the upper for local service, with stations every hundred yards apart; the second for express traffic, with stations every five miles apart. Everybody lives on the main line, within easy reach of the station. There are telephones, telegraphs, teleposts, parcel carriers, vacuum cleaners, and every possible convenience that can be conceived. The whole scheme is built upon the possibility of this high-speed transportation. Unfortunately, the railway recommended has never been tried, which is perhaps the most obvious objection. There can be no doubt that our methods of production are wasteful, partly because our system of transportation is bad or, as Mr. Chambless picturesquely expresses it, "civilization is a black cabinet of plates and doughnuts, arms and legs, and consuming mouths dancing around in an unco-ordinated fashion, occasionally getting together and serving one another, but more often missing the mark—two hands going to one mouth, another hand missing the mouth altogether. There is no plan, no unity, no harmony, no mind behind it all." In Roadtown he believes that he has devised a unified plan for the arrangement of the three functions of civilization—production, transportation, and consumption. It is impossible in this limited space to describe in detail Mr. Chambless's remarkable scheme. His idea is not merely to make living easier, not merely to use the rail, the pipe, and the wire for conveying the necessities of civilization cheaply and efficiently to the places where they are needed, but also to cure our social evils. In Roadtown, if Mr. Chambless is to be believed, there will not be simply low rents and low taxes, but no slums, pure politics, no poverty, no corruption—in fact, the ideals of the socialist will be attained, not by preaching to the multitude of the evildoing of the rich, or by pitting class against class, but by the simple mechanical and architectural expedient of stringing a city out in a line and building it above a high-speed railway. Of course, it is asking a good deal to accept all this on its face, but it must at least be admitted that Mr. Chambless has provided a book which, however fantastic it may seem, prescribes about as good a cure for the diseases of civilization as any we have encountered.

THE STANDARD OF LIVING AMONG THE INDUSTRIAL PEOPLE OF AMERICA. Hart, Schaffner & Marx Prize Essay. By F. H. Streightoff. New York: Houghton, Mifflin Company, 1911. 196 pp.; small 8vo. Price, $1 net.

The book is written with evident care and thoughtfulness, and displays a sympathetic insight into the conditions dealt with. It is impossible to read such a work without having one's interest aroused in the life of the less fortunate members of society, for whom the question, "What is a living wage?" is of such vital interest. The author estimates that "it is conservative to set $650 as the extreme low limit of the living wage in the cities of the North, East, and West." (The estimate is based on the supposition that the family consists of a man, his wife, and three children.) "If all industrial occupations are considered, probably four million men are not enjoying annual incomes of $600."

An idea of the general scope of the book may be gained from the chapter headings, which are as follows: I. The Standard of Living. II. Family Expenditures. III. Unemployment. IV. Incomes. V. Housing. VI. Food. VII. Clothing. VIII. Thrift. IX. Health. X. Intellectual and Social Life. XI. The Living Wage. XII. Possibilities. There is also a bibliography covering five pages. The book should prove valuable to the general public at large as well as to those who have a special interest in the subject treated, or who wish to have at hand in condensed form some of the principal facts and conclusions relating to the same.

WORLD CORPORATION. By King Camp Gillette. Boston: The New England News Company, 1910. 8vo.; 240 pp. Price, $1.

When a man of business takes to dreaming, he out-dreams the veriest visionary of them all. In justice to the man of business we must add that he very often makes his dream come true. Cecil Rhodes placed his finger on the map of Africa, and declared, "I want to see it all red!" King Camp Gillette sweeps his hand over the map of the world and says, "I want to see it all *white!*" His plan for giving every man his fair share of this world's blessings reads as absorbingly as a romance. He starts with the claim that the big corporation is a natural development in economic progress, and that it is of no use to attempt its control by legislation. His plan is to create a super-monster that shall swallow all the lesser monsters, one after another. The cells of this super-monster's organism are to be, not a limited number of stockholders, but all the individuals making up the population of the world. "World Corporation" is pledged to issue one share of stock to any one for every dollar paid in, at any time. As money comes in the securities of the great railroads and industrials are purchased—"removed from the speculative market forever"—and sooner or later "World Corporation" will own a controlling interest in everything worth having. When the process of absorption has achieved its end, and all the lesser monsters have disappeared within the maw of the benevolent Moloch, the stock of "World Corporation" is called in, and every man in the world is regarded as having a share in the wealth and workings of the all-embracing system. Government and politics will have been superseded by pure business having for its end and aim the good of mankind. Each branch of human activity will be presided over by its own department, each department having its necessary subdivisions. All men are to be workers; no drones are to be tolerated. Advancement is to be based strictly upon merit. As to individual remuneration, a system of competitive bidding between the departments and their subdivisions is to constitute a sort of balance-wheel by means of which no division will fail to attract labor, while the Department of Public Works will provide for any excess of workers over the number that can readily be assimilated by the other departments. While we feel sure that the present wielders of power would have a few strong cards to play before permitting this scheme to seriously menace their achievements, the proposition has been well thought out up to a certain point, and in its expression is incisive and fascinating.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12470) A. D. W. says: Two of your readers wish your decision on a certain argument as follows: Concerning the compressibility of water. A maintains that water is nearly incompressible. B maintains that it is susceptible of great compression. B also maintains that it has been proven that great enough depths of water exist to float solid pieces of iron or other heavy material, indicating that the specific gravity of water (or weight per cubic foot) is so great at great depths as to be capable of floating these heavy materials. A contests the truth of all this. Which is correct? A. According to the Smithsonian Physical Tables, which are of the highest authority, water is compressible 44 millionths of a volume per atmosphere. The density of sea water is 1.025, so that about 33 feet of sea water gives one atmosphere of pressure. At the greatest depth the water is about one twenty-fifth denser than at the surface. Steel is compressible 68 millionths per atmosphere, which is about one and a half times as much as water. Under the same pressure steel is compressed 1.5 times as much as water. Since steel is 7.7 times heavier than water at ordinary pressure and is compressed 1.5 times as much by any increase of pressure, it is not apparent how water can ever become as dense as steel. And if it is to float steel, it must be denser than steel. If any known substance will sink at the surface of the ocean, it will continue to sink entirely to the bottom at any depth. Prof. Davis of Harvard University, in his "Physical Geography," page 62, says: "Although water is easily moved, it is very little reduced in volume, even when compressed by great forces. Hence, in spite of the great pressure of the upper layers of the ocean on those beneath, the ocean is of nearly uniform density from top to bottom. Anything which is heavy enough to sink at the top will sink all the way to the bottom." For some reason we are having a number of letters about this just at present, and this statement ought to be convincing. There is no basis of fact for the belief that there is a place under water where heavy articles will remain in suspension, because the water has become dense enough to float them. Steel is the least compressible of the metals, and yet is 1.5 times as compressible as water. There are few if any substances less compressible than steel. So all things which sink at all in water must continue to sink more rapidly as they go deeper in the water.

(12471) W. B. R. says: Will you kindly tell me if you know of any tool or appliance used for bending delicate tubing such as is used in brass musical wind instruments, also for taking out dents in same? A. Thin metal tubes are bent without collapsing by filling them with melted resin, then bending them cold after the resin is hard. It might be necessary to heat the tube once or twice between successive stages of bending, so as to anneal the metal, if you find that the metal on the outside of the curve tends to become hard and brittle if the bending is carried out in one continuous movement.

(12472) S. B. J. asks: Will you please explain why, with the centrifugal force of the earth's revolution, removed when a person stands at a pole, the entire force of gravity would not cause his weight to be unendurable? A. It is demonstrated in mechanics that the centrifugal force of the earth reduces the weight of a body on the equator 1/289 of what it would if the earth were at rest. Thus, a person weighing 289 pounds, if the earth were at rest, would weigh 288 pounds on the equator with the earth rotating once in 24 hours as at present. Gravity makes the body weigh 289 pounds, and the centrifugal force of the earth's rotation at the equator lightens it 1 pound. It would not seem difficult to carry the extra pound if the earth should stop rotating, or to go to the pole, where the centrifugal force is zero. One would not know the difference in his weight by his senses, even if he weighed 289 pounds, and much less if he weighed less than that amount.

(12473) J. F. H. writes: I take the liberty to submit to you the following solution of query 12456: H. H. R. has unconsciously performed the operation given by Legendre (Book IV., Problem IV.) for dividing a line, such as *YC*, into extreme and mean proportion. From Legendre (Book V., Proposition VI.) we have the greater segment of a radius, divided into extreme and mean proportion, equal to the side of an inscribed decagon. By joining every other point, as *B* and *C*, we get of course an inscribed pentagon. The references are to Davies's Legendre, revised by Van Amringe.

Sir Hiram Maxim

(Continued from page 615)

dunnite in the States at the present time.

When a gun was required for firing on torpedo boats Messrs. Armstrong made a gun that could be fired by four men about ten rounds in a minute. It was a very clumsy affair. Hotchkiss made a much better gun which four men were able to fire nearly twenty rounds in a minute, and this was followed up by Nordenfeldt, who produced an extremely light and handy gun that four men succeeded in firing twenty-five rounds in a minute. All of these guns gave a very severe shock to the gunner, and an attempt was made to prevent them from recoiling at all. The next gun to make an appearance was Sir Hiram M xim's. This gun was provided with a much improved system of mounting which did not give the gunner any shock at all, and at the French trials, Sir Hiram, with no assistants, fired forty rounds in fifty seconds, making a record that has never been broken. The mounting of this gun was so much superior to all others that it has gone into use throughout the world on practically every form of gun. The novelty consists in placing the trunnions on a stationary sleeve and allowing the gun to recoil inside of the sleeve with a hydraulic buffer interposed between the buffer and the sleeve. All the apparatus for training the gun is attached to the sleeve instead of the barrel of the gun, thus completely eliminating the shock.

In 1889 Sir Hiram took up the subject of aerial navigation and after conducting a great number of experiments and considering the problem from every possible standpoint, it appeared to him that the best form of a flying machine would be what is known to-day as an aeroplane. The machine that he developed and made was practically the same as the best machines of to-day except that it was much larger and was driven by a steam engine instead of a petrol engine. It had the fore and aft horizontal rudders the same as the Farman machine of to-day, and the two screw propellers rotating in opposite directions the same as the Wright machine. This machine was 105 feet wide from tip to tip, and with 600 pounds of water and three men on board, it weighed 8,000 pounds. The engine power was 360 horse-power. The screws were of wood, 17 feet 11 inches in diameter, and collectively gave a screw thrust of 2,200 pounds, which propelled the machine along a railway track at the rate of forty miles an hour, giving a lifting effect of over 10,000 pounds. But the machine was altogether too large to be easily managed, and there was no room available in the neighborhood. It was, however, the first machine in the world that succeeded in lifting itself from the ground with a man on board.

At the last Paris Exhibition Sir Hiram was given the Personal Grand Prix in Artillery. He has also received high decorations from many governments. He was a director first in the Maxim Gun Company, then in the Maxim Nordenfeldt Company, and afterward for twenty-seven years in Vickers Sons & Maxim, Ltd., from which he resigned at the age of seventy-one. HIRAM S. MAXIM.

Our National Earthquake Recorder

(Concluded from page 616.)

the short end of the stylus lever *L*. Since the stylus lever cannot sweep over a much wider angle than that embraced within the width of the record sheet, it is essential that *P* also disengages under conditions of extreme motion with high magnification. This is accomplished by making the fork in the end of *L* and providing two small bristle brushes *B*, *B* to limit the motion of *L*. The lever cannot go beyond the brushes, and it can return only when the pin *P* is ready to engage the fork.

III. Three kinds of recorder have been tried: The photographic, the pen and ink and the smoked paper varieties. The last form is used in the seismograph at the Weather Bureau because it has been found that records thus produced show remarkable detail and completeness and can be produced with less expense. A pen and ink recorder is particularly inferior where high magnification is desired, on account of several mechanical difficulties including greater friction at the writing point. Besides, the danger of losing a record during a destructive earthquake through the stoppage of ink is much greater with the ink record than in the case of a stlyus tracing on smoked paper.

The paper is adjusted on the cylinder to form an endless belt, the ends being joined by lacing small metal ribbons into holes in the opposite ends of the sheet. This method of joining was adopted because the obstruction presented by the metal ribbon to the stylus is hardly appreciable. The cylinder moves at the rate of about 35 inches an hour. The drum is mounted in definite working relation to a small clock. A wheel in the clock train is connected with a screw, thus giving at the proper time an endwise motion whereby the sheet is displaced so that it may be traversed as many times as desired. An entire revolution of the drum is accomplished every hour. The records are changed every day.

In the registering of seismic shocks, it is extremely important that the exact time down to the fraction of a minute be easily determinable, both for setting the time of its occurrence and determining its duration. Formerly the time was marked independently of the stylus, but this method was unsatisfactory on account of the difficulty in determining the time correction. In the seismograph at the Weather Bureau the time is marked thus:

At the 30th second of each minute the standard time-keeping clock electrically releases the train of a secondary clock in the seismograph room. A slight movement ensues and cuts off the current to each vibrator. After exactly two seconds the secondary clock is again released and this time a strong current is sent instantly through all the recording levers to simultaneously produce time marks. As the cycle of actions is completed on the separate instruments, the stronger current is cut out and the vibration is again started. By this device Prof. Marvin compels the stylus to mark its own time.

It was found that a constant vibration of the stylus would lessen the friction very much, so a small vibrator has been devised which sets up sufficient tremors to keep the stylus arm in sustained movement. The low, continuous hum of this little contrivance is very pleasant to the ear.

The sheets of thin but strong record paper are blackened thus: The recording cylinder, upon which a sheet has been already mounted, is placed upon an iron support and exposed evenly to the smoke of a specially constructed lamp. The flat wick used is about 8 inches long and 1½ inches wide. A piece of tin a little longer than the wick and slightly narrower is bent longitudinally through the middle into a U-shaped trough. The wick is folded through the middle and inserted in the trough with the free edges projecting enough to light easily. Kerosene oil is used, being applied to the wick from the ordinary can used by machinists. An even flame and an increased volume of soot is induced by setting up about one-half inch away a flat plate of stiff sheet iron, which rises beside the flame to within a half inch or less of the recording drum.

The records thus obtained may be reproduced on sensitive paper in the same manner as photographic plates. They are preserved by varnishing on their smoked surface and drying while stretched horizontally between hooks with the face downward to keep off dust.

This seismograph is carefully isolated from local disturbance in its thickly-walled cell beneath the main building of the Weather Bureau, and every precaution is taken to protect it from draughts and from dust which might interfere with its extremely nice adjustment. Through its agency, earthquakes which occur in the remotest parts of the earth are recorded and many tremors so slight as to be unnoticeable elsewhere register themselves here. Thus, the recent upheaval that wrought such havoc in Mexico was known to have occurred long before the telegraph announced the fact. Truly the observer finds much to excite wonder in this delicate instrument.

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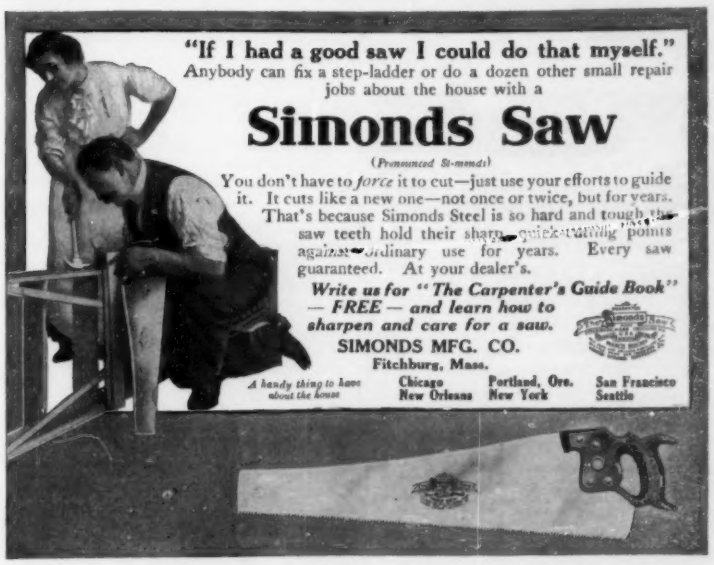

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Learning How to Fly

(*Continued from page 624.*)

"the feel of the air" is acquired can a man become an expert operator. By "feeling the air" is meant the ability to meet any contingency intuitively. When that is acquired, safe flying is assured, and is dependent only on the integrity of the planes, controls and motor. By using the rudder discreetly, and by banking simply far enough to partially offset the centrifugal force of turning, no ailerons or warping wings are necessary in still air. Even too short a turn can be corrected by a quick use of the rudder.

The torque of the motor renders it advisable for a novice to turn a machine to the right, if a right-handed propeller is used, and to the left if a left-handed propeller is used. If two propellers are employed turning in opposite directions, as in the Wright machine, there is no inequality from the torque of the motor. Since torque is not noticeable on any machine on a straight course, recourse to straight flying will always serve the aviator if he finds himself in trouble on the turn. If the use of rudders and ailerons has reduced the forward speed, a downward glide will increase it again. If the motor should stop on the turn, such a downward glide is immediately imperative. When the machine is thus gliding, a change in the fore-and-aft balance becomes at once apparent, because the blast of the propeller no longer acts on the tail. It will be found that the elevator must then be used with greater amplitude to produce the same effect.

Before flights in other than calm air are attempted, much practice is required. The machine must be inspected over and over again, and the wind variations must be studied with a watchful eye. Not until this familiarity with machine and atmosphere is acquired should flying in the wind be attempted. To the man on the ground, wind is simply air moving horizontally. To the man in the air, it is disturbed air. Not only must he consider horizontal movement, but vertical draughts and vortices as well. A rising current of air lifts a machine; a downward current depresses it; horizontal currents affect forward speed over the ground; swirls and vortices create inequalities in wind pressures on the planes, and disturb lateral balance. Familiarity with all these atmospheric conditions can be acquired only with long practice.

Against every tree, house, hill, fence and hedge beats an invisible surf of air. In other words, there are upward currents on one side and down draughts on the other. The upward draught is not usually dangerous, for it simply lifts the machine; but the down draught will cause the machine to drop. A swift downward glide under the full power of the motor must then be made, to increase the forward speed, and consequently the lift. That is why Chavez's flight through the Alps was so remarkable a performance.

Starting and Landing in a Wind.

A machine should always be started and landed in the teeth of a wind. An old air dog may disregard this advice, but not the novice. The precaution is necessary because in landing the aviator should always travel straight ahead, without the possibility of lurching, and consequently breaking a wing. Contact with the earth is necessarily made at a time when the machine is traveling over the ground at a speed of 30 or 40 miles an hour, and skidding sideways at the rate of 10 or 15 miles an hour, all circumstances which tend to wreck an aeroplane. If the aviator attempts to land with the wind at his back, he will find it hard to avoid a sharp turn and side skidding.

Planning the Flight.

It is easy to lose one's way in the air. For that reason, it is best to follow the Wright idea of starting out with a definite plan, and of landing in some predetermined spot. Aimless wandering about may prove disastrous to the inexperienced aviator. He may forget which way the wind was blowing, or how much fuel he had, or the character of the ground beneath him. Should his motor stop, he may make an all too hasty decision in landing. It is easy enough to lose one's bearings in the air, not only because the vehicle is completely immersed in the medium through which it travels, but also because the earth assumes a new aspect from the seat of an aeroplane. Cecil Grace was one of those who lost his bearings, and, as a consequence, his life.

Ordinary winds blowing over a level country can be negotiated with comparative safety. Not so the puffy wind. To cope with that constant vigilance is required, particularly in turning. In a circular flight in a steady wind, the only apparent effect is that the earth is swept over faster in one direction than in the other. Before a cross-country flight is attempted, the starting field should be circled at a great height. Not until then may the long distance flight be attempted with safety.

Cross-country flying is, of course, fascinating. It is a sore temptation, at an altitude of a few hundred feet, to throw all caution to the winds and to fly off over that strange country below, which is, indeed, a new land, viewed from aloft. Here the greatest self-restraint must be exercised. Not until the necessary practice has been acquired, not until the right kind of confidence has been gained, may one of these trips be attempted, and then only after it is properly planned.

Leicester Allen

DR. LEICESTER ALLEN died on June 6th, 1911, at his late residence, 36 Seventh Avenue, Brooklyn, after a lingering illness of several months. The immediate cause of death was heart disease, and the exhaustion of old age. Dr. Allen having just passed his 79th birthday.

Dr. Allen was a descendant of Col. Ethan Allen of Revolutionary fame, and was born in the central part of New York State, in Madison County, and was educated and graduated as a doctor of medicine, but never practised this profession, but devoted his life to scientific journalism, invention and literature.

Dr. Allen was a man of considerable literary, scientific and inventive ability, and wrote a good deal for scientific and other journals. He was at one time editor of the SCIENTIFIC AMERICAN, and later on formed a partnership with Henry E. Brown, patent solicitor, under the firm name of Brown & Allen, who published a mechanical and scientific paper known as the *American Artisan*.

After Dr. Allen retired from the firm of Brown & Allen he was editor of the *Scientific News*, which paper was published for a short while by Salem H. Wales & Son, Mr. Wales having been one of the original publishers of the SCIENTIFIC AMERICAN, and which paper was finally absorbed by the SCIENTIFIC AMERICAN in the early eighties. Subsequently Dr. Allen devoted himself to invention and journalism, and produced some valuable inventions, one of the best known being the Allen's dense air ice machine, which is used on board almost all of the warships in the United States for refrigerating purposes, being very effective and safe for this purpose, on account of having no dangerous fumes to deal with, as in the ammonia machines, which would be unsafe aboard ship.

Dr. Allen was a man of high character, fine sentiments, and strong friendship, highly respected and deeply regretted by his friends.

The Current Supplement

THE International Hygiene Exposition which was opened in Dresden last month, is described in the opening article of the current SUPPLEMENT, No. 1851.—An air propeller testing apparatus devised by Prof. Prandtl is described and illustrated.—Mr. Randolph I. Geare writes entertainingly on the cocoanut palm.—The third of Sir J. J. Thomson's Royal Institution lectures on radiant energy and matter is summarized.—A new system of perforating metal, devised by Mr. Andrew Smith, is discussed.—Mr. Jacob Backes discusses the new type for typewriters, and traces the history of the effort to provide a typewriter with type which shall be more like that of the printing press and the linotype machine.

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INDEX.

The * Indicates that the Article is Illustrated with Engravings.

Aborigines, American *89
ACETYLENE.
—Compressed storage of.....453
—Ups and downs of.....447
Acheson, Edward G., and Edison....*142
Aerating apparatus for fish tanks...*286
AERONAUTICS.
—Aims and accomplishments.....462
—Aviators and designers, American, *472, European *473
—Flags for air yachts.....502
—Flying in a wind.....422, 498
—Law of air.....303, 447, 584
—Notes.....79, 103, 127, 151, 191, 215 239, 293 318, 341, 365, 418, 437, 458 494, 514, 537, 558, 612
—Upper air research, British.....422
—Wireless telegraphy 489
—Wright infringement suit, France..601
—See also Aeroplanes; Balloons and Airships.
AERONAUTICS, ACCESSORIES.
—Compass for aeroplanes.....*230
—Height recorder for balloonists....*196
—Hydroplane floats *196
—Metal for aeroplane construction...101
—Parachutes for aviators.....*300
—Propellers.....*159, *270, *468
—Safety belts for aviators.....*300
AERONAUTICS, ACCIDENTS.
—Air sickness and aviation accidents.570
—Airship disasters, recent.....*543
—Death roll 28
—Descent, steep, death in.....86
—Dirigibles, accidents, lessons.....535
—Grace, lost 7
—Hoxsey's death, *43; cause *66
—Moisant and Hoxsey, death.....*43
—Monoplane accidents, recent.....*108
—Safety belts for aviators.....*300
—Wind, danger of flight in.....422, 498
—Why men are killed.....*464
—Zeppelin, how to handle.....547
AERONAUTICS, EXHIBITIONS AND CONTESTS.
—Bellinger, Paris to Bordeaux and Pau 221
—Curtiss hydro-aeroplane flight.....*132
—Ely's flight from "Pennsylvania".*108
—Feats of flying, recent.....*106, 298
—Gordon-Bennett trophy, French preparations *407
—McCurdy's flight to Havana.....*132
—N. Y. Aviation Show.....28
—Paris-Madrid race *543
—Paris-Rome-Turin race *563
—Passenger-carrying record (11)....*407
—Puy de Dome flight.....*324
—Records, aeroplane and automobile.518
—Records, Los Angeles meet.....7
AERONAUTICS, MILITARY AND NAVAL.
—Aerial navy vs. dreadnought.....*475
—Automobiles for airship guns.....*66
—English navy dirigible "NI".....235
—Wright biplane, Texas.....*324
AERONAUTICS, NOMENCLATURE.
—Aviation, volation, flying.....272
—Dictionary of aeronautics.....490
—Voiator and volar.....272
—Volator and volation.....199
AERONAUTICS, PRIZES.
—Aviation prizes at home and abroad.475
—Michelin grand prize winner.....*324
—Royal Aero Club awards.....364
—See also Gould Scientific American prize, Scientific American trophy.
AEROPLANES.
—Blériot "Bus".....*221
—Curtiss hydro-aeroplane *196
—De Pishof *85
—Flying machines in leash *3
—Hydro-aeroplane, Curtiss *132
—Hydroplane floats *196
—Kaufmann monoplane *159
—Metal for aeroplane construction...101
—Multiple engines for passenger-carrying aeroplanes 398
—Ovington's Blériot *388
—Passenger-carrying record (11)....*407
—Paulhan's biplane *85
—Pelterie monoplane *159
—Propellers, how made, *270; Pettit's, *159; Theory.....*468
—Reefing aeroplane 82
—Safety device for aircraft.....*159
—Six men and 100 h. p. *3
—Stability automatic *470
—Variable speed aeroplane.....*523
—Voisin "Canard," *424; military. *248
—Wings made impervious.....*553
—Wright army biplane.....*324
AGRICULTURE.
—Alfalfa crop menace.....198
—Colleges and schools.....189
—Cotton picking machine.....*231
—Holmes's art crop.....131
—Irrigation investigations 364
—Motor competition, Canada.....162
—Motor on the farm.....*177
—Motor truck vs. horse.....*36
—New machines and methods..*155, 170
—Nitrogen, fixation of.....287
—Power, electric, on farm.....*380
—Rain, artificial *384
—Science of soil.....*168
—Weather bureau and farmer.....*175
—Wheat crop, world's.....117
Air brake, invention of.....602, C.T.
Air, law of.....303, 447, 584
AIRSHIPS. See Balloons and Airships.
Air sickness, aviation accidents.....570
Alcohol, incandescent mantle using..*379
Alfalfa crop, menace.....198
Alibi, proved by picture.....*114
Allan, Dr. Leicester, obituary.....632
Alloy for aeroplanes.....101
Alloys, metal, defects.....551
Aluminium industry, progress.....360
Anemometer, home-made *507
ANIMALS.
—New, creating *164
—Protective coloring, Thayer.....3
—Transporting with oxygen.....*61
Antarctic expedition, Australian.....557
ARCHÆOLOGY.
—Coins and bankers, ancient.....350
—Cretan relics *328
—Cyrene, and Dr. Herbert de Cou...446
Archives, national, in danger.....562
Armatures, suggestions for rewinding *15
Armor, new 462
Arrhenius, Svante August.....*157
Arrhenius's theory of glacial periods.601
Art crop, Holmes.....131
Artist's mistakes 296
Ashpan for furnace *228
Asteroids, April, notes on.....*326
Asteroid seen with small telescope...117
ASTRONOMY.
—Evolution stellar, new researches...601
—Fleming, Mrs., obituary.....547
—Le Verrier centenary.....350
—Meteors, velocity 219
—Nova Lacertae, prediscovery of.....203
—Observatory, astrophysical, Mexico.394
—Solar photographs, stereoscopic effects 199
—Stereoscopic combinations of comet photographs *600
—Studies of Aurora.....*10
—Universe, a mechanism.....*251
—Vacant regions in Milky Way.....*499
—See also Eclipse; Moon; Planets by name; Sun; Telescopes.
Athletes, diet of..... 64
ATLAS.
—American, wanted 242
—Zoogeography 491
Auginbaugh, W. L., obituary.....288
Aurora, audibility of.....621
Aurora Borealis *10, *138
AUTOMOBILES.
—Advertising with *301
—Airship gun transports.....*66
—Electric tricycle, Beff.....*522
—Electric vehicle *31
—Farmers' use of automobile.....162
—Fire engine, New York, 424; Service, *306; Water tower.....*220
—Gasoline-electric omnibus, London's, *241-244
—Horse clipping with.....*430
—Inexpensive cars *34
—Labor-saving electric trucks.....*197
—Motoring on runners.....*124
—Polar automobile sleigh.....*385
—Power uses of.....449
—Propeller-driven, on skates.....*124
—Repainting old car.....30
—Searchlight, automobile, mounted...*347
—Shop repairs *38
—Snow automobile, Austrian.....*124
—Street sweeper and sprinkler.....*522
—Water tower *220
AUTOMOBILES, ACCESSORIES.
—Cylinder lubricating oils.....44
—Edison's storage battery.....*27-30
—Garage, inexpensive *42
—License numbers, how concealed..*522
—Pneumatic substitute for spring...*120
—Road guides, mechanical.....*33
AUTOMOBILES, DEVELOPMENT.
—Cars of 1911.....*40
—Decorating Madison Square for show 53
—Madison Square Garden Show.....82
—Motor truck vs. horse.....*36
—Records, aeroplane and automobile.518
—Selden patent 58
AVIATION.
—Europe in advance of America....623
—Learning how to fly.....*624
—Two-cycle aeroplane motor, N. E. C. *626
—Two-cycle motor, N. D. C.....*626
—Two-cycle motor, N. E. C.....*626
Axe handle, removing.....*408

B

Bacteria, lineage 547
Balance, chemical, delicate.....*355
BALLOONS AND AIRSHIPS.
—Aerological observations, Nebraska.198
—Brucker transatlantic expedition.*57-62
—Christening "Suchard" 304
—"Deutschland II." wrecked.....*543
—Dirigible of to-day.....*461-466
—Dirigibles, accidents, lessons.....535
—Gas for non-inflammable.....199
—Height recorder *196
—"Kreli I.," Siemen's non-rigid type *248
—"Morning Post" wrecked.....*453
—Rigid dirigible, English navy, "NI" 235
—Wireless telegraphy and Zeppelin's.270
—Zeppelin, how to handle.....547
—See also Aeronautics; Aeronautics, military.
Ballbearings and sockets, machine.....*333
Bankers and coins, ancient.....350
Barometer, freak *71
BATTERY.
—Carbons, copper connections.....*432
—Motor combined *357
—Seven-cent *507
—Storage, home-made *253
Bayard, F. *255
Bean, jumping 399
Bell, Alex. Graham, ice stove.....602
Billings, C. C., Asst. Com. Patents.*255
BIRDS.
—Archaeopteryx *91
—Nuptial plumage 90
—Prodigals and vandals.....355
Bit brace, emergency.....*334
Bits, how to sharpen.....*118
Bits, how to use.....*179
Blandy, H., resignation of.....453
Brass threading, reducing friction...452
—Transatlantic airship expedition.*57-62
—President of Argentine Republic....75
Blasting with compressed air.....552
Blue-printing, hints 409
BOATS.
—Catamaran in suitcase.....*430
—Landing float for.....*530
—Tiller ropes, locking up slack.....*97
—Unsinkable *288
—See also Motor boats.
Boiler tubes, removing.....*409
Bolts, fishing for.....625
Bolts, wire spikes used for.....409
Boracic acid 443
Bore walls, measuring deviation....*500
Boring engine cylinder on lathe.....*625
BORING.
—Cleaning hole *15
—Crank-pin hole *408
—Glass 15
—Holes, methods *179
—Square-bottomed hole *286
BOTTLES.
—Glass labeling *254
—Vacuum-jacketed evolution *383
Bowling alley, novel.....*93
Brace for bit, emergency.....*334
Branly, Edouard *323
Brass pipe, holding in vise.....409
Brass threading, reducing friction....452
Brasses, crown, how turned.....*119
BRIDGE.
—Chains tested 442
—Quebec bridge *501
—Wrecking by electricity.....83
Briquettes *444
Briquetting metal shavings.....161
Brown, W. C. *587
BRUCKER.
—Airship christened 304
—Transatlantic airship expedition.*57-62
Brush wiper for paint brushes.....*536
Brushes, shellac, cleaning.....409
Brussels, port of.....571
Building, artistic 442
Bullet, photographing *357
Bullet, velocity of.....*15
Bunsen centenary 372

C

Calipering over flange.....*229
Calipering webs and chambered holes *333
Camera. See Photography.
CANAL.
—Improvements, Germany 506
—Locks of St. Mary's River.....*546
Canes, weapons in.....*93
CARS.
—Armored, Mexican revolution.....*410
—Mission style *206
—President of Argentine Republic.... *5
—Railroad clearance and curvature..*410
—Rescue, for mines..... 8
—Steel railroad car.....584
Carat, international 236
Carbon disulphide, optical experiment *252
Carborundum, to true up.....334
Carnegie Institution at Washington.*109
Carty, J. J. *16
Case for phonograph records.....*228
Cast made with electric arc.....*15
Casting gold centrifugally.....*119
Castor oil plant, poison.....161
Catamaran in suitcase.....*430
Catgut from silkworms.....223
Catskill water supply, tunnel.....*621
Cellulose, sugar from.....326
Celtium, new element.....252
CEMENT.
—Cathedral, concrete 141
—Era 268
—Farm uses *166
—Iron in concrete.....457
—Locks of Panama Canal.....*282
—Market *267-278
—Odd uses of concrete.....*279
—Oil cement 139
—One-piece house *276
—Ornamental concrete *284
—Poured house, Edison.....272
—Signs of cement.....*14
—Tile, concrete, home-made.....*334
—Tree surgery *275
—Waterproofing problems *273
—What is Portland cement?.....274
Cereals, cryptogamic maladies.....450
Chains, bridge, tested.....442
Chanute, Octave *463
Chasms, strange ocean.....437
Chemistry and public welfare.....429
Chemistry, international congress....501
Chimney, smoke dissipating.....*550
Cholera and immigration.....443
Chuck, protecting threads.....*452
Church, Melville *312
Cicada, seventeen-year locust.....*524
Cigarette paper 491
Cigars, banding by machine.....*433
Circle, length finding.....*119
Circle, squaring *6
Clamp, glue *625
Clamp, tool-makers' *452
Clark, Edgar E. *586
Clements, Judson C. *585
Clinometer, McGeorge *500
CLOCK.
—Bottle containing *311
—Decimal dial *97
—Electrically driven *4
—Speaking 77
Clouds, fringes of.....205
Coal dust engine.....*508
Coal, good and poor.....*376
Coins and bankers, ancient.....350
Coins, counterfeit, baby's bank.....449
Colors, journalistic 399
Colwell, J. H. *553
Comet photographs, stereoscopic combination *600
Comets, demonstration of orbits.....*205
Compass for aeroplanes.....*230
Concrete. See Cement.
Cone center dividers.....*229
CONGRESSES.
—Applied chemistry, international...501
—Pan-American 198
—Protection industrial property....*312 454, 508; Opening, *531; Work...573
Constitution, U. S. document in danger 562
Contact clip, electrical.....*140
Copyrights, convention on.....232
Cotton packing machine.....*231
Counterfeit coins and baby's bank...449
Country Court house in City Hall Park 498
Cowles, W. A. *553
Crank-pin hole, boring.....*408
Crete, sea kings of.....*328
Crown brasses, how turned.....*119
Cryptogamic maladies of cereals....450
Curie, Madame, and Academy of Sciences 58
Curtiss, Glenn H., career.....*349
Cushion, pneumatic, for automobiles..*120
Cutter, for strawboard *14
Cylinder, reboring on lathe.....*625
Cyrene, and Dr. Herbert de Cou...446

D

Dairy, investigation 355
Dampening machine *120
Decade, starting Sunday 94
Declaration of Independence, document in danger.....562
Depths of ocean.....437
Deserts, how formed.....427
Desk, school question.....*64
Dewar, Sir James *107
Diabolo, human *93
Diamonds, artificial 287
Die, hardening 14
Die, right-hand, cutting left-hand..*333
Diet of athletes..... 64
Dinosaur, mummy *505
Dinosaurs, restoration *345, 352
Disease, cutaneous, treating with cold 405
Diver's vocation *129, 133
Dividers, cone center.....*229
Dock, dry, biggest.....*445
Docks, increased facilities, N. Y.. *441, 446
Docks. See also Piers.
Documents, charred restoration of....521
Dog, speaking 223
Door stop, magnetic *568
Doors, suggestions on hanging.....530
Drain, clog, starting.....*179
Drawing with reflecting apparatus..*507
DRILLS.
—Center drill, to prevent breaking..409
—Cleaning hole *15
—Drill presses, home-made.....*334
—Lathe, made from.....*334
—Needle *334
—Sewing machine needle.....530
—Small, to prevent breaking.....*568
—Socket, handy *409
Dry dock, biggest.....*445
Duell, C. H. *312
Duster, automatic, for poultry.....*336
Duties, preferential. See Merchant marine.
Dynamite as railroad builder.....*620
Dye, analine in cure of diseases.....519
Dye woods, indentification of.....618
Dynamite disaster, Communipaw.....130
Dynamite on the farm.....163

E

Ear, electro-magnetic *311
Earthquake recorder, national.....*616
Earth's core 557
Eclipse, solar, 1911.....*402
EDISON.
—Acheson's days with.....*142
—Poured house 272
—Storage battery *27, 30
Education and success.....542
Efficiency engineering, standardized operations 600
Eggs preserved with water glass.....227
Ehrlich, Hata *519
ELECTRIC APPARATUS AND APPLIANCES.
—Carpet sweeper *626
—Cast made with electric power.....*15
—Contact clip *140
—Disk electrometer *622
—Electrical invasion of home.....*381
—Electroscope made of a board and cane *253
—Fabrics electrically heated.....*552
—Fountain *622
—Leyden jar charger.....*205
—Lightning conductors, design.....*623
—Pendulum *622
—Rheostat, home-made *119
—Smoke-condensing apparatus *622
—Steam boiler, electrically heated..571
—Torch lighter *119
—Trousers creaser *17
Electric batteries. See Batteries.
Electric bridge wrecking.....83
ELECTRIC LIGHTING.
—Cut-off for gas-lighting circuit....*229
—Lamps of to-day.....*379
—Light and power on farm.....*380
—Light of the future, inventing....*382
—Neon light 189
—Tungsten lamps vs. rates.....372
ELECTRIC MOTORS.
—Armatures, suggestions for rewinding *15
—Battery and motor combined.....*357
—Miniature motor *206
Electric power on the farm.....*380
Electric power, Paris plant..... 5
ELECTRIC RAILROADS.
—France and Switzerland recent projects 93
—Trunk railroad electrification..... 2
—See also Rapid transit.
Electric tension *622
Electrical Notes...23, 55, 78, 102, 126 150, 190, 214, 238, 261, 294, 318, 342, 365, 395, 438, 458, 493, 514, 538, 578, 635
Electricity, future of.....308
Electricity, static, phenomenon.....*199
Electrolytic, iron 323
Electron, magneton 551
Electroscope, made of a board and cane *253
Element, new, celtium.....252
Emotions and morals.....451
Emu 377
Engineering, artistic 442
Engineering Notes ...23, 55, 78, 102, 126 150, 190, 214, 238, 263, 294, 319, 342, 366, 438, 459, 494, 538, 612
Engine, coal dust.....*508
Engines. See also Internal Combustion engines; Steam engine.
Equilibrium and rest positions.....*88
Eskimos *89
Everglades, draining *67
EXHIBITIONS.
—Automobile show, Madison Square Garden 82
—Aviation show, New York.....28
—Decorating Madison Square Garden for Automobile Show.....53
—Motor boat show, New York.....246
—Paris exposition, 1920.....162
—Turin and Rome expositions.....203
EXPERIMENTS.
—Inverted retinal images.....*549
—Light experiments *432
—Nitric oxide liquefaction.....204, 254
—Nitrogen peroxid, liquefaction.....*70
—Optical experiments with liquids..*253
—Static electricity phenomenon.....*199
Eyeglass, monocular, Pince-Nez.....*250
EYES.
—Cause of squint.....*138
—Inverted retinal images.....*549
—Observation, training powers of.....242
—Night vision 156
—"Telegraphic eye" 335

F

Fabrics electrically heated.....*552
Face, right and left.....*90
Fan, hair-drying *122
Fan on grinder spindle.....*409
Film developing machine.....*359
Fire, restoration of charred documents 521
FIRE SERVICE.
—Automobile fire engine.....424
—Automobile service of New York..*306
—Automobile water tower.....*220
—Chutes as fire escapes.....498
—Fire drills in factories.....346, 403
—Forest fires 341
—Oil lost by burning wells.....350
Firefly, light of.....435
Firewall, Manhattan's 243
Fish, Frederick P. *312
Fish tank, aerating apparatus.....*286
Fish, transporting with oxygen.....*61
Flags for air yachts.....502
Fleas as plague carriers.....*226
Fleming, John Ambrose.....*137
Fleming, Mrs. W. P., obituary.....547
Floor smoothers, spring-driven.....*430
Flour sifter *336
Flowers, color of.....269
Fly, harm done by.....*160
Foehn wind, effects.....405
Fog and fog signals.....227
Fog investigations needed.....106
Fountain, electric *622
FOOD.
—Diet of athletes..... 64
—Lactal ice cream.....149, 252
—Queer foods 252
—Saccharin in 490, 502
—Sea water 77
Footstools, dangers *203
FORGE.
—And anvil *181
—Effect of copper in.....286
—Home built *180
Forest and field as hospitals..... 87
FORESTRY.
—Fires in forests.....341
—Private ownership of timberland menace 322
—Water supply and forests.....525
Forts, old battleships as.....*245
Foundry ladles, suggestion.....*286
FRUIT.
—Oranges, freezing point of.....220
FUEL.
—Coal, good and poor.....*376
—Heat from dust.....*444
—Nile sudd 212
—Oil, precautions 227
Furnaces, wind 550
Fuses for explosive shells.....*411

G

Gage, depth *119
Gage, wire, standard needed.....223
Galton, Sir Francis.....*83
Garage, inexpensive *42
GAS.
—Drawing charge in gas plant.....377
—Lighting circuit, cut-off for.....*229
—Natural gas 501
—Safety gas valve.....*144
Gas and gasoline engines. See Internal Combustion Engines.
Gaskets, making removable.....469
Gasoline tank detecting leaks.....469
Gayley, James W. *16
Gear problem, solutions.....*403
Gem production, U. S.....618
Geyser in Florida *206
Girders, giant, for municipal building *243
Glacial periods, Arrhenius's theory...601
Glass, boring 15
Glass, dissolving in water.....341
Glass, polishing powder for.....317
Gloves from old parchments.....311
Glow worm, light of.....435
Glue clamp *625
Glycerine 256
Goethals, Col. G. W.....*561, 567
Gold, casting centrifugally.....*119
Gold, metals more precious..... 88
Golf ball dynamics.....*198
GOULD SCIENTIFIC AMERICAN PRIZE.
—Editorial comment 614
—Multiple engines for passenger aeroplanes 398
—Rules governing the competition, 111, 298, 487, 526
Gramophone, eliminating scratching noise 571
Grand Central station, N. Y...*585, 594
Grinder, power-driven *568
Grinder spindle, fan on.....*409
Guides, road, mechanical.....*33
GUNS.
—Childress silencer *336
—Powder and our naval guns.....322
—Report mufflers *95
—Support for automatic guns.....*17
—Torpedo high speed vs. big gun....*406
GYROSCOPE.
—Kite *122
—Monorail, Schlowsky *94
—Monorail, toy *206
—Moving pictures 574

H

Hair-drying fan *122
Hall, G. Stanley.....*589
Hammer head fastening.....*119
Hammer, rawhide *229
Hand car, motor substitute.....*508
Harlan, James S. *586
Hata-Ehrlich *519
Head noises, how studied.....*307
HEAT.
—From dust *444
—Hottest 227
—Measuring by sound.....*503
Heating the home.....*378
HEAVENS.
—January *9
—February *116
—March *249
—April *332
—May *431
—June *548
Hero's fountain as an ornament.....*254
Hesse, Frederick G., obituary.....143
Hinges, suggestions on.....530
Holt, W. W., obituary..... 7
Hook worm, soil pollution.....149
Hooker, J. D., Mt. Wilson reflecter..618
Horse clipper, automobile-driven.....*430
Hospital, forest and field as..... 87
Hudson Boy, shore tipping up.....394
HUMAN MECHANICS.
—Equilibrium and rest positions.....*88
—Man-machine *60
Humidifier for workshops.....329
Hydro-aeroplane, Curtiss *196
Hydro-comparators, simple *310
Hydrophobia *595
Hydroplane, Forlanini's *205
Hygrometer, simple *254
Hygroscopes, quaint and curious....*589

I

Ice cream, lacto.....149, 252
Ice stove, Dr. Bell's.....602
ILLUMINATION.
—Brida' veil falls, Niagara.....*371
—Direct-indirect fixture, home-made.*408
—Experiments on light.....*432
—Fixture for shipping room.....*408
—Fluorescent reflector *379
—Indirect and direct-indirect.....*374
—Lamps of to-day.....*379
—Light and shadows.....*374
—Light of the future, inventing....*382
—Light window, artificial.....*379
—Tasteful use of light.....*375
ILLUSIONS.
—Colored shadows *141
—Mirror illusion *71
Immigration and cholera 443
Indians, American *89
Industrial property, protection congress *312, 454, 508
Opening, *531, Work.....573
Industrial Schools, Thaddeus Stevens.203
Industries, secrecy in.....422

Inheritance, of size and shape..... 92
Insect ridden timber..... 53
Intellect, triumph over instinct..... 302
Intelligence, measuring..... *91
INTERNAL COMBUSTION ENGINE.
—Coal dust engine..... *508
—Diesel motor neglected..... 82
—Engine muffler underground..... *568
—Loss of power at high altitude..... 405
—Marine oil engines, progress..... 283
—Motor-driven steamships..... 508
—Power, industrial, in Southern States..... 331
—Producer-gas engines for marine use..... 28
—Self-igniting oil engine..... 218
—Steam in gas engines..... *547
—"Valveless" gas engine..... *480
Interstate Commerce Commission, members..... *585
Interstate commerce law..... *585
INVENTIONS.
—Air brake, invention of..... 602, 627
—Brief notes..97, 121, 144, 209, 256, 288
—Notes for inventors..... 232, 313, 356, 361, 386, 413, 484, 509, 532, 554, 573, 603
—See also Patents.
INVENTORS.
—Inventor and the Patent Office..... *235
—Pan-American Union..... 232
—Prize of $20,000..... 7
—Professional inventor..... *16
—See also Inventions; Patents.
Irrigation, artificial rain..... *384
Irrigation, investigations..... 364
IRON.
—Behavior in concrete..... 457
—Castings, softening..... 118
—Corrosion..... 149
—Electrolytic..... 323
—Machinery, corrosion of..... 527
Ironing board, step ladder and clothes rack..... *396
Island broken up by plants..... 611

J

Jade, Maori warrior on..... *552

K

Kapp, Gisbert..... *195
Khaki, evolution..... 430
Keyways cut on lathe..... *179
Kite, gyroscopic..... *122

L

Ladies, suggestion for..... *286
Lakes tipped by winds..... 418
Lamp lighter, electric..... *119
Landing float..... *530
Lane, Franklin K..... *586
LATHES.
—Emergency..... *14
—Hand drill from..... *334
—Planing curved surface with..... *452
—Squaring work in..... 334
Launch. See Motor boat.
Lawn mower, gasoline propelled..... *506
Le Verrier centenary..... 350
Leather, artificial..... 519
Leaves, how kept clean..... 130
Leaves, why they fall..... *250
Lettering tracings, device for..... *452
Leyden jar charger..... *205
Library, Public, New York..... *517, 527
Lightning conductors, design..... *623
LIGHT.
—Glow worm..... 435
—Experiments on..... *140
—Sound waves and..... 571
—See also Electric lighting; Illumination.
—Lightning conductors, design..... *623
Liverpool port, improving..... 356
Lock, 1,350-foot Sault Ste. Marie..... *546
LOCOMOTIVES.
—Apple locomotive..... *124
—Development of..... *590
—French and Hungarian engines..... *325
—Why engine moves..... 477
Locust, seventeen-year..... *524
Log skidding and loading machines..... *311
London traffic problem..... *428
Longevity, study of..... 356
Loyd, Samuel, obituary..... 412

M

McCheed, Charles C..... *586
Machine, human..... *60
Machinery, iron, corrosion..... 527
Machinery trade, hints for extension, 198, 222
MacNab, John F..... *531
Magnetic snake..... *141
Magnetism, new constituent of matter..... 551
Mail boxes, improved..... 94
Mail system, Pennsylvania Railroad station..... *105, 110
Maxim, Sir Hiram..... *615
Medicine and mathematics..... 622
Mathematics and medicine..... 622
"MAINE" RAISING.
—Uncovering the "Maine"..... *199, *617
—Stability of cofferdam..... 427
Man, breeding better..... 562
Man-machine..... *60
Management, scientific..... 600
Manager, to manage..... 130
Maori warrior on jade..... *552
Maps, drawing from nature..... *397, 400
Marage's, Dr., work..... *307
Marching, physiology of..... 219
Marble, steam passed through..... 61
Match patent, dedication..... 143
Mathematics, applications in science..... 450
Mattress, air, ancient..... 144
Maxim, Louis W..... *335
Measurements, refined..... 194
Meat, scarcity and preservation..... 161
Mechanical problem, solutions..... *403
MECHANICS.
—Experimental..... *202
—See also Human mechanics.
MERCHANT MARINE.
—American merchant marine..... 526
—Analysis of American..... *421, 426
—Free ship question..... 526
—Our decadent merchant marine..... 194
—Preferential duties..... 403, 427
—Preferential duties, why not revive..... 322
METALS.
—Alloys, defects..... 551
—Bending edgewise..... *14
—Briquetting shavings..... 161
—Coating metals, new method..... *572
—Disease in metals..... 29
—Distinguishing by sparks..... 451
—More precious than gold..... 88
—Waves in..... 446
METEOROLOGY.
—Aerological observations, Nebraska..... 198
—Aurora Borealis..... *10, *138
—Barometer, freak..... *71
—Barometric pressure, highest in Europe..... 536
—British office, new..... 405
—Farmer and Weather Bureau..... *175
—Foehn wind, effects..... 405
—Fog and fog signals..... 227
—Fringes of clouds..... 205
—Hygrometer, simple..... *254
—Hygroscopes, quaint and curious..... *599
—Observations in British colonies..... 87
—Southernmost station..... 219
—Storm signals, international..... *64
—Summary for New York, December, 1910..... 39
—Upper air research, British..... 422
—Wind vane and indicator..... *70
Meteors, velocity of..... 219
Meyer, Balthasar H..... *586
Michelson, Albert Abraham..... *15
Micrometer tool..... *15
MILITARY ART AND SCIENCE.
—Armored cars, Mexican revolution. *410
—Nocturnal warfare..... *347
—Physiology of marching..... 219
—See also Aeronautics, Military and Naval; Guns; Ordnance.
Milk supply, hygienic..... 287
Milky Way, vacant regions in..... *499
Milling machines, oil stops..... *118
Mimicry, protective coloring, Thayer. 3
Mimicry, with mimic left out..... 87
MINING.
—Compressed air..... 552
—Educating miners..... *193-200
—Fighting death in mines..... *193-200
—Prize for safety lamp..... 573
—Rescue cars for mines..... 8
MIRROR.
—Body bracket for..... *97
—Illusion..... *71
—Problem..... 86
Miter box for odd angles..... *228
Monocle, substitute for..... *256
Monorail, gyroscopic, Schilowsky..... *94
Monorail, gyroscopic, toy..... *206
MOON.
—Harvest..... 112
—Power, utilization of..... 303
—Stars occulted by..... 326
Moore, E. B..... *255
Mooring sail for launches..... 530
Morals and emotions..... 451
Mosaic curtain, Mexican theater..... *425
Moth parasites, importation..... 310
MOTOR BOATS.
—Hoist cover for..... *530
—Meeting, Monaco..... *448
—Mile-a-minute..... 372
—Mooring sail for..... *530
—Show, New York..... 246
—Spray sails for..... *530
Motor car built by boy..... *311
Motor on the farm..... *177
Motor substitute for hand car..... *506
Motor truck, accident..... *430
Motorcycles of 1911..... 44
Mower, gasoline, propelled..... *506
Mower, submerged weeds..... *506
Muffler, underground, for gas engines..... *568
Municipal building, giant girders..... *243
Musical instruments, Strauss..... *476

N

NAVAL MATTERS.
—Aerial navy vs. dreadnought..... *475
—Battleship sinking at six miles, *321-330
—Building at navy yard vs. private yard..... 346
—Europe outbid on battleships..... 442
—Firing line aboard "North Dakota," *541-544
—Guns and powder..... 322
—Navy yards, getting rid of..... 542
—Old battleships as permanent forts..... *245
—Old engineer corps..... 86
—Politics and battleship costs..... 272
—Reciprocating engine, Renaissance. 584
—Reciprocating engines, a step backward..... 2
—Scientific management..... 542
—See also Warships.
Nebulae..... 250
Needle factory, prehistoric..... 430
Neon light..... 189
NEW YORE.
—Court house in City Hall Park..... 498
—New York Central R.R.Terminal, *583-594
—Population, future..... *526
—Public Library..... *517-527
—Riverside development..... *441-446
Newspaper science..... 346
Newton, James J..... *359
Niagara Falls illumination..... *371
Niagara Falls threatened again..... 518
Niagara Falls, preservation..... 614, 619
Night vision, fantastic..... 156
Nile, green water of..... 451
Nile sudd, fuel from..... 242
Nitric oxid liquefaction..... *70, 204, 254
Nitrogen, fixation of..... 287
Nixon, George A..... *626

O

Obelisk, St. Peter's, curious history. *500
Observation, training the powers of. 242
Observatory, astrophysical, Mexico. 384
Ocean chasms..... 437
Oceanograph Institute, Paris..... 242
OIL.
—Automobile cylinder lubrication..... 44
—Freak shadows in..... 111
—Fuel on ocean liners..... 218
—Fuel, precautions..... 227
—Lost by burning wells..... 350
—Stops for milling machines..... *118
—Stove-oil..... 452
Oil Engines. See Internal combustion engines.
Old, growing..... 356
"Olympic" docked..... *445
"Olympic" at New York pier..*613-619
Omnibus, Edison's storage battery. *27-30
Omnibus, gasoline-electric, London's, *241-244
Opeidescope..... *205
Oranges, freezing point of..... 221
Orchestral instruments, Strauss..... *476
ORDNANCE.
—Fuses for explosive shells..... *411
—Powder, Hiram Maxim's experience..... 181
—Shell, curious..... *144
—Smokeless powder..... 117
—Smokeless powder, cure best..... *63
—Support for automatic guns..... *17
Ostwald, Wilhelm..... *423
Oxygen, novel method of obtaining.. 402
Oxygen, transporting fish..... *61

P

Packing for export..... 513
Paint bucket brush wiper..... *530
PALEONTOLOGY.
—Archaeopteryx..... *91
—"Mummy Trachodon"..... *505
—Restoration of extinct animals, *345, 352
PANAMA CANAL.
—Fortification necessary..... 218
—Goethals, Col. G. W..... *561-567
—Mammoth locks..... *282
—Peru, our relations with..... 113
—Problems of..... 562
—Work nobly done..... 2
Pan-American congress..... 198
Pan-American union and inventor..... 232
Papermaking, starch in..... 236
Parcels post, better, demand for..... 542
Parchments, what becomes of..... 611
PARIS.
—Electric plant..... 5
—Exposition..... 102
—Seaport..... 195
Park, County Court house in..... *498
Parkinson, Robert H..... *312
Pasteur treatment..... *565
PATENT OFFICE.
—Articles encountered..... 481
—Commissioners and Examiners..... *255
*335, *559, *531, *553, *572, *626
—Models to sell..... 63
—New assignee's index..... 553
—Staff, changes..... 121
PATENTS.
—Diamond match patent, dedication. 143
—German-American treaty abrogation..... 385
—Government employees and patents. 54
—Legal notes..97, 144, 209, 357, 360, 413, 433, 454, 509, 532, 574, 627
—Marconi vs. British Radio Co..... 412
—Patent expert..... 504
—Report of commissioner..... 143
—Russian patent law..... 96
—Selden patent..... 58
—Statistical data in commissioner's report..... 182
—Trade-mark and patent treatise, new..... 208
—Wright infringement suit, France. 601
—See also Inventions; Inventors.
Peary, investigating..... *404
Peary vs. Macon..... 398
Pencil-sharpening attachment..... *122
Pendulum, electric..... *622
Pennsylvania station, mail system, *105-110
Perfume statistics of a botanist..... 223
Perpetual motion, capillary..... *403
Preservation, instrument for testing. *91
PHONOGRAPH.
—Eliminating scratching noise..... 571
—Improvised..... *254
—Records, case for..... *228
PHOTOGRAPHY.
—Centenary in photography..... 462
—Film developing machine..... *539
—Full sight view finder..... *90
—Gyroscope and compressed air in moving pictures..... 571
—Invisible ray photography..... *570
—Objective twenty-five-cent..... *549
—Photo-micrography for amateurs. *310
—Portrait attachment for pocket camera..... *204
—Projectile photography..... *357
—Shutter-speeds testing..... *358
—Stereoscopic camera..... *358
—See also Astronomy; Photography.
Phosphorescence..... 202
Picture framing outfit..... *568
Piers, longer, for New York..186, *125, *158, 162, 298, *613-619
PIPE.
—Brass, holding in vise..... 409
—Lead, repairing bottom wall..... *229
—Fuller, home-made..... *286
—Wrench, fie..... *408
Plague and its spread..... *476
Plague-carriers, fleas..... *226
Planes, iron, lubricating..... *452
Planets, morning and evening stars for 1911..... *134
Planets, notes on..... *326
Planing cylinder on lathe..... *452
Planing work square in lathe..... 334
PLANTS.
—Advance of plant life..... 269
—Arctic and Antarctic..... 437
—Island, broken up by..... 611
—Leaves, how kept clean..... 130
—New animals and plants..... *164
—Prodigals and vandals..... 355
—Radium emanations, effect..... 429
—Resurrection plant..... 384
—Venus flytrap..... *61
Plating, new method..... *572
Plumb-line in Porto Rico..... 506
Pneumatic mattress, ancient..... 144
Poison, vegetable..... 161
Polar exploration, rewards and penalties..... 398
Polar observations of Peary..... *404
Pole, locating, by observations of Venus..... 246
Pond, Benjamin W..... *572
Population, future, of Greater N. Y. *526
Post parcels, better, demand for..... 542
Potato, new..... 447
Poultry duster..... *336
POWDER. See Ordnance.
Power from moon..... 303
Power from solar radiation..... *95, 106, 117, 162, 223
Pragmatism in science..... 287
Prize for safety lamp..... 573
Prize, inventor's, $-0,000..... 7
Problem, geometrical, attacked..... 223
Problem, mechanical..... *162
Producer-gas. See Internal combustion engines.
Projectile photography..... *357
Property, protection, congress. *312, 454, 508; Opening, *531; Work..... 573
Prouty, Charles A..... *586
Pseudo fabrics..... *450
Psychological apparatus, testing perseveration..... *91
Pulley, grooved, experimental..... *118
Punch for boiler shops..... *334
Pyrometer, musical..... *503

Q

Quebec bridge, competitive designs for..... *501
Quebec bridge, Scientific American and Canadian Parliament..... 268

R

Radiator, repairing..... 286, 409
Radiography..... *112
RADIUM.
—Crystallization in super-saturated solutions..... 29
—Emanations on plants..... 429
—Inhaler..... *551
Rafter, Giles S..... *572
RAILROADS.
—Car, mission style..... 206
—Car, president of Argentine Republic..... *5
—Clearance and curvature car..... *410
—Dynamite as railroad builder..... *620
—Economics of scientific management..... 596
—Electrically heated steam system.. 571
—Growth of American locomotives. *590
—Interstate commerce law..... *585
—Magnitude of leading lines of the world..... *596
—Relations to the public..... *587
—Steel car..... *584
—Terminal, world's greatest..... *583-594
—Transcontinental lines of Canada. *592
—Transcontinental systems in U. S. *588
—See also Rapid transit.
Rain, artificial..... *384
Rainbow, night..... 447
RAPID TRANSIT.
—Edison's storage battery omnibus, *27-30
—Manager, to manage..... 130
—Traffic problem in London..... *428
Reamer, hastily constructed..... *286
Reamer, Rose, adjustable..... *408
RECLAMATION.
—Everglades, draining..... *67
—Fill on Hudson River shore..*441-446
—Service, indorsement of..... 58
Reflecting apparatus for drawings..*507
Resurrection plant..... 384
Rheostat, home-made..... *119
Riverside extension, New York. *441-446
Riveting, why light blows used..... *452
Roads, public..... 364
Rochow, Ferdinand J., obituary..... 336
Roentgen ray, development..... *112
Roosevelt dam, dedication..... *271
Roosevelt trophies..... *569
Rosin, removing..... 452
Rugs, electric thermat..... *552

S

St. Mary's River canal..... *546
Saccharimeters..... *247
Saccharin in food..... 490
Saccharin, why valueless..... 502
Safety lamp, prize for..... 573
Salt process, Hodgkinson..... 256
Sand blast for labeling bottles..... *224
Sand blast, German use..... 569
Saturn's rings, variations..... *6
Saw, level and projector..... *144
School desk question..... *64
School, industrial, Thaddeus Stevens. 303
Seismograph, our national..... *616
Smoke-condensing apparatus..... *622
SCIENCE.
—Breeding better men..... 562
—Notes..... 22, 54, 79, 105, 127, 151, 191, 215, 239, 263, 295, 319, 343, 367, 395, 419, 459, 495, 515, 539, 559, 635
—Philosophy of..... 577
—Pure and applied..... 577
—Pure and public weal..... 309
—Newspaper Science..... 346
—Spirit of..... 298
—Unification of..... 614
—Women and scientific research..... 77
SCIENTIFIC AMERICAN.
—Canadian Parliament and S. A. 268
—Comments by readers..135, 327, 351
—Gould-Scientific American prize, 111, 298, 398, 487, 526
SCIENTIFIC AMERICAN TROPHY.
—Curtiss wins..... *29
—Presentation to Glenn H. Curtiss. *348
—Sport for sport's sake..... 346
Scissors grinder, power-driven..... *506
Screens, window painting..... 334
Screws, how to remove..... 180
Screws, shortening..... *286
Screws, small, how to insert..... *530
Scribner, C. E..... *16
Searchlight, automobile mounted..*347
Seawater, liquid fuel..... 77
Secrecy in modern industries..... 422
Secretary Bird..... 377
Seismological station, Königsberg..... 513
Selden patent..... 58
Sericulture, scientific..... *354
Sewer, linking city to farm..... 242
Sewer water and vegetables..... 270
SHADOWS.
—Alibi proved by..... *114
—Colored..... *141
—In oil..... 111
—Mountain, queer..... 557
Shaft-centering device..... *122
Shaft-turning with emergency lathe. *14
Shell, for artillery, curious..... *424
Shellac brushes, cleaning..... 409
SHIPS. See Merchant Marine; Piers; Steamships and Steamboats.
Shutter-speeds testing..... *358
Sifter for flour..... *336
Signals, used in map making..... 409
Silencer for guns, Childress..... *256
Silkworm, culture..... *354
Silkworms, catgut from..... 223
Silvering reflectors..... 358
Skin disease, treating with cold..... 405
Skinner, F. C..... *255
Sleeping sickness, combatting..... *373
Sleigh, automobile, polar type..... *585
Smoke and soot..... 504
Smoke dissipating chimney..... *350
Snake, magnetic..... *141
Snow, sun bath in..... *206
Soap-nut tree..... *250
Sockets and bolts, machining..... *333
Soil, science of..... *168
Soldering leak in radiator..... 286
Soot and smoke..... 504
Sound and light waves..... 571
Sound-proof room..... 447
South sea warrior on jade..... *552
Spark gap, self-cooled..... *70
Sparks, distinguishing metals..... 451
Speed taking of machine without centers..... *409
Spray sails for launches..... *530
Spring wheels..... *335
Squint, cause of..... *138
Stakes, hints on cutting..... *179
Stamp slitting and rolling machine. *207
Starch in papermaking..... 236
STARS.
—Evolution stellar, new researches. 601
—New star in Lacerta..... *224
—New stars..... 156
—Nova Lacertae, predicovery of..... 203
—Nova 3, Sagittarius..... 137
—Occultations by Moon, April..... 326
Steady rest jaws, copper in..... *452
Steam boiler electrically heated..... 571
STEAM ENGINES.
—Gas and steam combined..... *547
—Naval reciprocating engine, Renaissance..... 584
—Reciprocating engines, step backward..... 2
—Rotary, home-made engines..... *568
Steam passed through marble..... 61
STEAMSHIPS AND STEAMBOATS.
—Anti-rolling tanks..... *497-502
—Diminishing rolling..... 429
—Oil fuel on ocean liners..... 218
—Motor-driven steamships..... 508
—Turbine steamer construction..... 156
STEEL.
—Corrosion..... 149
—Hardening tool steel..... 469
—High speed, to anneal..... 118
Steinmetz, Charles Proteus..... *443
Step ladder, clothes rack and ironing board..... *336
Stereoscopic camera..... *358
Stewart, T. G..... *255
Stomach, hardware in..... 451
Stools, dangers..... *203
Storage battery, home-made..... *253
Storage, meat..... 161
Strauss, orchestral instruments..... *476
Strawboard, cutter for..... *14
Street sweeper and sprinkler, motor-driven..... *522
Stud-bolts removed without alligator..... *286
SUBMARINE.
—"Kobben" for the Norwegian navy, *297-299
—New submarine boat..... 275
—Rescue of German submarine..*585, 587
Success and education..... 542
Sugar from cellulose..... 326
Sugar, how tested..... *247
Sulky, bicycle trotting..... *122
SUN.
—Photographs, stereoscopic effects. 199
—Power, utilization of..... *65, 106, 117, 162, 223
—Total eclipse of 1911..... *402
Sunday, first day of decade..... 94
Sundials, National Museum..... 117
SURVEYING.
—Plane table..... *397-400
—Plumb-line in Porto Rico..... 506
—Simple methods..... *180
Swells, South Sea..... *621
Swimming lessons for children..... *506
Syphilis, cure..... *549

T

Table, laying-off..... *118
Talking machine, improvised..... *254
Tark, gasoline, detecting leaks..... 409
Tap, right-hand, cutting left-hand..*333
Target, electric recording..... *139
Target hitting at seven miles..*541-544
TELEPHONY AND TELEGRAPHY.
—Major Squier's multiplex system..*59
—Ruhmer's multiplex system..... *359
—Rural telephone movement..... 162
—Underground conduit, New York to Washington..... 149
Telecradiography..... *112
TELESCOPES.
—Hooker, J. D., Mt. Wilson reflector..... 618
—Reflector 4½-inch construction..... *204
—Silvering reflectors..... 358
Television, Rösing system..... *305
Temperature, highest..... 227
Temperature, measuring by sound..*503
Tennant, F. A..... *255
Theater curtain, mosaic..... *425
Thompson, Silvanus Philipps..... *219
Threading brass, reducing friction..... 452
Threads, left-hand, cutting..... *333
Thumb screw, insulated..... 141
Ticket-making machine..... 287
Tide motors..... 303
Tile, concrete, home-made..... *334
Tiller ropes, slack taking up..... *97
Timber, insect-ridden..... 53
Timberland, private ownership, menace..... 322
Time, Greenwich standard in France. 377
Tobacco pipe, eucalyptus..... *506
Tomb, tallest in England..... *552
Tool combination..... *122
Tool, universal..... *151
Tortoise shell..... 101
Trade-mark and patent treatise, new. 208
Tree surgery..... *275
Trees, tallest..... 430
Tricycle, Beff, electric..... *522
Trousers creaser..... *17
Truck, motor, accident..... *430
Tubes, removing from boiler..... *469
Tubing, bending..... 452
Tubing, thin, sawing..... 180
Tunnel, Catskill water supply..... *621
Tungsten lamps vs. rates..... 372
Tungsten wire..... 358
TURBINES.
—Hydraulic valve..... *217, 222
—Largest hydraulic turbines..... *304
—Reciprocating engines, a step backward..... 2
—Steamer construction..... 156

U

Ultra-violet rays, paper sensitive to. 201
Ulysses, wanderings of..... 201
Umbrella, handle repair..... 14
Universe, a mechanism..... 551
University, German, reorganization... 354

V

Vacuum cleaner, electric..... *626
Vacuum-jacketed bottle evolution... *385
Valve grinder..... *286
Valves, electrically operated... *217, 222
Vanadium, test for..... 223
Van't Hoff, J. H..... 252, *369
VENUS.
—Locating pole by..... 377
—Lowell's theories..... *308
—Observations, locating the pole..... 246
Venus flytrap..... 61
Vibration, instrument for demonstrating..... *205
Vise anvil and forge..... *181
Vise, holding brass pipe in..... 409
Vision, savage over-rated..... 302
Vision. See also Television.

W

Wall paper, lightproof..... 503
Wall paper trimming machine..... 223
WARSHIPS.
—Aerial navy vs. dreadnought..... *475
—American ideas in British battleships..... *520
—Argentine battleships, new..... 117
—"Arkansas"..... *114
—Armored ships, relative strength.. 86
—Battleship vs. destroyer..... *406
—Dreadnought vs. pre-dreadnoughts. *303
—Europe outbid on battleships..... 442
—Firing line aboard "North Dakota"..... *541-544
—Japanese cruiser, powerful..... 296
—Japanese dreadnought "Aki"..... *356
—"Monarch" modified "North Dakota"..... *520
—Old battleships as permanent forts..... *245
—Politics and battleship costs..... 272
—Reciprocating engines, a step backward..... 2
—"San Marcos" ("Texas") under fire..... *321-330
—World's navies, armored ships..... 86
—See also "Maine" raising; Naval matters.
Water-jacket, non-freezing connections for..... *229
Water tower, automobile..... *220
Waterproofing cement..... *273
Water spouts..... *564
Water supply and forests..... 525
Water supply tunnel, Catskill..... *621
Waves, anti-rolling tanks..... *497-502
Waves in metal..... 446
Waves, South Sea..... 621
Weapons in walking sticks..... *95
Weeds, submerged, mowing..... *506
Welding, prevented by copper in forge..... 286
Westinghouse, future of electricity. 308
Westinghouse, invention of air brake, 602, 627
Wheat crop, world's..... 117
Wheelbarrow, runner attachment... *336
Wheels, elastic spoke..... *335
Whip socket lock..... *17
Wilkinson, Dr. A. G..... *531
Willows, basket, breeding strains.... 20
WIND.
—Danger of flight in..... 422, 498
—Foehn, effects..... 405
—Furnaces..... 559
—Lakes tipped by..... 418
—Vane and indicator..... *70
—Velocity measured by pressure.... *507
Windmill, Nantucket..... 223
Windmill, Nantucket, 1746..... *84
Wire gage, need for standard..... 223
Wire stretcher..... *333
WIRELESS TELEGRAPHY AND TELEPHONY.
—Aeronautic wireless telegraphy.... 489
—Detector and tuner combined.... *552
—Electro-magnetic car..... *311
—High-frequency generator..... 477
—Marconi patent vs. British Radio Company..... 412
—Multiplex telephony and telegraphy..... *59
—Rubmer's recent work..... *230
—Sensitive relay..... *141
—Spark gap self-cooled..... *70
—Zeppelins and wireless..... 270
Women and scientific research..... 77
Wood bending in nature..... *96
Wood collecting, National Museum... 194
Woolard, W. F..... *255
Workshops of Europe..... 198, 222
Wrench, pipe, file..... *408
Wright infringement suit, France.... 601

X

X-ray, modern development..... *112

Z

Zinc ore reducing with petroleum.... 424
Zoogeography, atlas of..... 491
Zoological Park, New York..... *1-11

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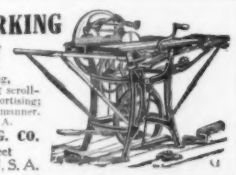

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Electricity

Wireless Station at Spitzbergen.—It is reported that the Norwegian Government is going to establish a wireless telegraph station at Spitzbergen. This will be the "farthest north" for wireless telegraphy, and it will undoubtedly be of value to explorers in Arctic regions. Its distance from the Pole will be but 800 miles.

The First Commercial Transformer.—The use of electricity is so widespread, and its development is so great, that we are apt to overlook the fact that in point of years it is one of the youngest and most precious of industrial sciences. Only the other day the twenty-fifth anniversary of the construction of the first commercial alternating transformer was celebrated. This transformer was built by Mr. William Stanley, who has presented it to the American Institute of Electrical Engineers.

Fans as Fly Screens.—An enterprising business man in Mobile, Ala., has installed a ceiling fan over the entrance to his store to prevent flies from coming in. He has found that this form of fly screen is very effective, and does away with the bother of having a screen door for his patrons to open and slam shut. Heretofore flies would enter when the door was opened, and would collect in the display windows, making it necessary to clean the windows and the display objects frequently. Now he has no such trouble. Other business men are adopting this simple expedient.

Moving Picture Central Station Advertising.—The Commonwealth Edison Company of Chicago has adopted a novel scheme of advertising the advantages of electric cooking, washing, ironing and cleaning. A moving picture exhibition is given at one of the amusement parks, which shows a kitchen fitted with the usual dirty coal range and a hired girl that spends so much time in attending to the range that she cannot prepare the meals on time. The story of the usual household difficulties is told pictorially, and it ends finally in showing the contrast after the husband has decided to get rid of the coal nuisance, and has introduced electricity in the kitchen and laundry.

Static Charges in Spinning Mills.—One of the difficulties which have to be contended with in spinning mills is the fact that electro-static charges caused by friction make the threads repel each other so that there is a considerable loss due to this cause. To overcome the difficulty a method has been employed in France which was described recently in a paper read before the French Academy. It consists in using high tension currents of high frequency in wires stretched over the textile materials. This tends to negative the static charges, reducing the waste and producing a certain elasticity in the product. Heretofore the static charges were combated by using a moist atmosphere which necessitated closing the factory windows and thus hindering ventilation. By the new method, such unsanitary conditions are obviated.

Electrically-operated Grain Elevator.—The deep-water terminal of the Boston & Albany Railroad at East Boston, Mass., is being completely electrified. One of the principal improvements consists in an electrically-operated grain elevator with a capacity of a million bushels, which is equipped with fifty induction motors of nearly 2,200 horse-power. When it is desired to start a motor, the operator presses a button, which signals the fact to the switch-room. Here the motor is connected to auxiliary bus-bars carrying either 40 per cent or 58 per cent of the normal voltage. After the motor is brought up to requisite speed, it is connected to the main bus-bars. When the motor has reached its full speed, as indicated by an ammeter, the fact is signaled by the switchboard attendant, whereupon the operator at the motor applies the load. An interesting emergency stop system is provided. When the emergency button is pressed, a stopping switch is thrown into operation, which opens the circuits of the motors nearest the elevator first, and the rest consecutively, so that the entire system is stopped without piling up the grain in any one place.

Science

Industrial Use of Volcanic Ash.—For some time past a company in Japan has been engaged in exploiting the use of volcanic ash in combination with Portland cement mortar. This combination is said to be particularly valuable in the construction of works submerged in salt water. It is claimed that the cement thus formed possesses greater tensile strength, and is denser, than ordinary Portland cement. It is also more resistant to the percolation of water. It is thought that should this industry prosper it might well be extended to the Philippines, where a great deal of volcanic ash is available.

Drawn and Undrawn Market Poultry.—The United States Department of Agriculture has published a bulletin by M. E. Pennington, on the comparative rate of decomposition in drawn and undrawn market poultry. The conclusions are that: (1) Undrawn poultry decomposes more slowly than does poultry which has been either wholly or partially eviscerated. (2) "Fulldrawn" poultry, that is, completely eviscerated, with heads and feet removed, decomposes the most rapidly. (3) "Boston drawn" and "wire drawn" stand midway between the undrawn and full drawn in speed of decomposition. The "wire drawn," which is most like the undrawn, is usually the better.

Platinum.—Jewelers have decided that platinum is hereafter to take the place of gold as the precious metal of fashion, so cheap and common has the once precious metal of antiquity become. "What," asks an editorial writer in the New York *Tribune*, "is to become of the golden wisdom of our proverbial philosophy?" Indeed, the proverbial and literary consequences of the change are found more formidable than may appear at first blush. "Silence," it is suggested, "may turn from golden to platinum in the speech of our descendants. . . . But they will continue . . . to quote Shakespeare's beauties unchanged, to speak still of gilding refined gold, as well as painting the lily, to be as rich in her hour of happiness as twenty seas, if all their sands were pearl, the water nectar and the rocks pure gold."

The Kahn Traveling Fellowships.—The first two incumbents of the Kahn traveling fellowships for American teachers are announced by Secretary Fackenthal of Columbia University. They are: Prof. John H. T. McPherson, professor of history and political science in the University of Georgia, Athens, Ga., and Prof. Francis Daniels, professor of Romance languages in Wabash College, Crawfordsville, Ind. Prof. McPherson is a native of Baltimore, Md., and was graduated from the Johns Hopkins University with the degree of A. B. in 1886, receiving the degree of Ph.D. in 1890. After one year's service as fellow in history at Johns Hopkins, and one year as instructor at the University of Michigan, Prof. McPherson was appointed to his present chair in 1892. He is a member of a number of scientific and historical societies and the author of a number of books and pamphlets. Prof. Daniels was graduated at the University of Michigan in 1895, and became teaching fellow in Latin at the University of Missouri, where he received the degree of A.M. in 1897. In the following year he was Hopkins scholar at Harvard. After several years of advanced study and teaching experience at Kansas City and at Colorado College, he became professor of Romance languages in Cornell College, Iowa. Two years ago Prof. Daniels was called to his present professorship in Wabash College. The Kahn fellowships have been established for this country by Albert Kahn of Paris, the intention being to send for a year's travel abroad, men whose tendencies are toward research and broadening their sphere of influence, and who have not the means at their disposal to carry out their ideas. The men are to be chosen each year, preferably from smaller institutions of learning in the South and West, and they are permitted to visit any country they choose for observation, provided their itinerary is submitted to the trustees of the fund for approval. The present incumbents will travel for a year from July 1st, 1911.

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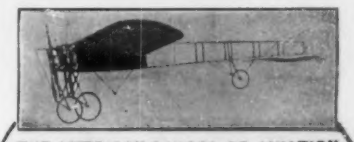

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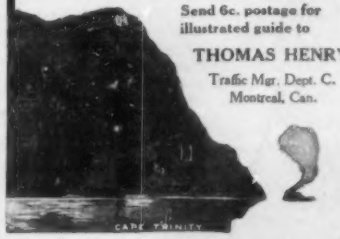

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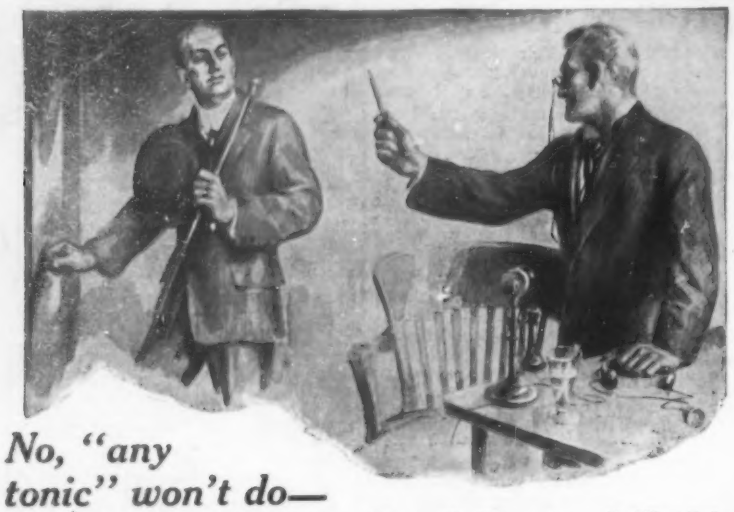

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